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TRANSACTIONS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY.

VOL. X.

TRANSACTIONS

OF THE

HERTFORDSHIRE

NATURAL HISTORY SOCIETY

AND

FIELD CLUB.

EDITED BY JOHN HOPKINSON, F.L.S., F.G.S.,
Assoc. Inst. C.E.

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December, 1897, to June, 1900.

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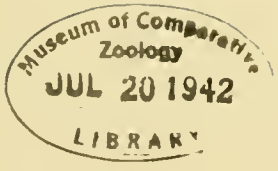

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Dates of publication of the several parts contained in this volume:

Part 1.	Pages 1–32	November, 1898.
,, 2.	,, 33–68	February, 1899.
,, 3.	,, 69–104	May, 1899.
,, 4.	,, 105–152	September, 1899.
,, 5.	,, 153–192	September, 1900.
,, 6.	,, 193–232	December, 1900.
,, 7.	,, ix–xl	March, 1901.
,, 8.	,, xli–lxxvi	May, 1901.
,, 9.	,, i–viii, and 233–248	July, 1901.

Dates of publication of previous volumes:

TRANSACTIONS OF THE WATFORD NATURAL HISTORY SOCIETY.

Vol. I.	(pp. lxiv and 248.)	August, 1878.
,, II.	(pp. lx and 260.)	June, 1880.

TRANSACTIONS OF THE HERTFORDSHIRE NATURAL HISTORY SOCIETY.

Vol. I.	(pp. lxviii and 272.)	May, 1882.
,, II.	(pp. lxviii and 286.)	May, 1884.
,, III.	(pp. lxxii and 274.)	March, 1886.
,, IV.	(pp. lii and 224.)	June, 1888.
,, V.	(pp. xlviii and 224.)	May, 1890.
,, VI.	(pp. lxx and 204.)	July, 1892.
,, VII.	(pp. lii and 244.)	April, 1894.
,, VIII.	(pp. lxxii and 212.)	November, 1896.
,, IX.	(pp. lxxviii and 252.).....	August, 1898.

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201st Ordinary Meeting, 8th December, 1897, at St. Albans.

William Whitaker, B.A., F.R.S., F.G.S., Assoc. Inst. C.E., President, in the Chair.

Mr. Donald Harvey Attfield, M.A., M.B., C.M., D.P.H., Ashlands, Watford; Mr. Thomas Morgan Harvey, Bohun Lodge, East Barnet; Miss Geraldine Keating, Cannon Mill Cottage, Chesham; Mr. George Pearson, Brickendonbury, Hertford; and Mr. Henry J. Worssam, Marlborough House, St. Albans, were proposed for membership of the Society.

The following paper was read :—

"British Parasitic Flowering Plants, with a List of the Species." By James Saunders. (*Transactions*, Vol. X, pp. 44–48.)

The paper was illustrated by specimens of the parasitic flowering plants which were described by the author.

Mr. A. E. Gibbs, F.L.S., drew attention to an interesting paper on the distribution of the oxlip in Britain read before the Linnean Society by Mr. Miller Christy.* It was stated that the oxlip occurred within two sharply-defined areas in the eastern counties, one of which included small portions of Hertfordshire east and north-east of Bishop's Stortford. Our county was thus only affected to a slight degree. Mr. Gibbs gave some of Mr. Christy's conclusions and referred to the care with which his investigations had been conducted.

A map showing the areas in which the oxlip occurs, kindly lent by Mr. Christy, was exhibited.

Mr. Hopkinson remarked that with the exception of the alkanet (*Anchusa officinalis*) which had lately been found at Barley by the Rev. J. Frome-Wilkinson, but was merely a casual, the oxlip was the only species which had been added to the county flora since the publication by the Society of Pryor's 'Flora of Hertfordshire.'

* "*Primula elatior* in Britain: its Distribution, Peculiarities, Hybrids, and Allies." 'Journ. Linn. Soc.,' Botany, vol. xxxiii, pp. 172-201, pl. xi (1897). Distribution in Herts, p. 184.

202ND ORDINARY MEETING, 14TH DECEMBER, 1897, AT WATFORD.

WILLIAM WHITAKER, B.A., F.R.S., F.G.S., Assoc. Inst. C.E., President, in the Chair.

Mr. D. Harvey Attfield, Mr. T. Morgan Harvey, Miss Geraldine Keating, Mr. George Pearson, and Mr. Henry J. Worssam were elected Members of the Society.

Mr. Frederick Goodyear, Fallow Corner, North Finchley, was proposed for membership.

The President announced that the Council had resolved to accept an offer made by Mr. H. George Fordham to prepare for the Society a catalogue of Hertfordshire maps. He hoped that members and others who possessed old maps of the county would give Mr. Fordham particulars of them.

The following lecture was delivered:—

"A Visit to Canada and the Falls of Niagara." By John Hopkinson, F.L.S., F.G.S., Assoc. Inst. C.E., Hon. Sec.

This was an account of a visit to Quebec, Montreal, Toronto, Niagara, etc., made in August by Mr. Hopkinson, who attended the Toronto meeting of the British Association as Secretary to the Conference of Delegates of Scientific Societies, and represented the Society at this Conference.

The lecture was illustrated by a large number of photographic views shown by means of the Society's oxy-hydrogen lantern.

203RD ORDINARY MEETING, 25TH JANUARY, 1898, AT WATFORD.

WILLIAM WHITAKER, B.A., F.R.S., F.G.S., Assoc. Inst. C.E., President, in the Chair.

Mr. Frederick Goodyear was elected a Member of the Society.

Mr. Henry John Ryman, Thorpedale, Chorleywood, Rickmansworth, was proposed for membership.

The following lecture was delivered:—

"Nature on and around Mount Sinai." By D. Harvey Attfield, M.A., M.B., D.P.H., late Medical Officer to the Egyptian Maritime and Quarantine Board of Health.

The lecture was illustrated by numerous lantern-views, chiefly from photographs taken by the author.

Mr. Arthur P. Blathwayt and Mr. Alfred E. Cox were elected Auditors of the Accounts for the year 1897.

23RD ANNIVERSARY MEETING, 22ND FEBRUARY, 1898.
(AT WATFORD.)

WILLIAM WHITAKER, B.A., F.R.S., Pres. G.S., Assoc. Inst. C.E., President, in the Chair.

The Report of the Council for the year 1897, and the Treasurer's Account of Income and Expenditure, were read and adopted.

The President delivered an Address entitled "Chalk Water in Hertfordshire." (*Transactions*, Vol. X, pp. 1–13.)

The following gentlemen were duly elected as the officers and Council for the ensuing year :—

President.—William Whitaker, B.A., F.R.S., Pres.G.S., Assoc. Inst. C.E.

Vice-Presidents.—Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas.R.S., V.P.S.A., etc.; T. Vaughan Roberts; George Rooper, F.Z.S.; Arthur Stradling, M.R.C.S., F.Z.S.

Treasurer.—John Weall.

Honorary Secretaries.—John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc., Assoc.Inst.C.E.; W. R. Carter, B.A.

Librarian.—Daniel Hill.

Curator.—A. E. Gibbs, F.L.S., F.E.S., F.R.H.S.

Other Members.—John Attfield, M.A., Ph.D., F.R.S., F.C.S.; Charles Ashdown, F.C.S., F.R.G.S.; Arthur P. Blathwayt; F. M. Campbell, F.L.S., F.Z.S., F.R.M.S.; Alan F. Crossman, F.L.S.; Herbert George Fordham; F. C. Mahon; John Morison, M.D., F.G.S.; George P. Neele; William Page, F.S.A.; James Saunders; W. Lepard Smith.

The thanks of the Society were accorded to Dr. John Morison, F.G.S., retiring from the office of Vice-President, and to Mr. Edward Mawley, F.R.Met.Soc., Mr. William Ransom, F.S.A., F.L.S., and Mr. G. Herbert Wailes, Assoc.M.Inst.C.E., retiring from the Council.

Report of the Council for the Year 1897.

The Council of the Hertfordshire Natural History Society, in presenting the 23rd Annual Report, regrets to announce that there has again been a falling-off in the number of members, although not nearly to the same extent as in the previous year.

During the year ten ordinary members have been elected; one member has compounded for his annual subscription; ten members have resigned; and the Council regrets to have to record the loss of five members by death—three life members, Mr. John Larkin, Mr Thomas James Mann, and Major Henry Reynolds Solly; and two annual subscribers, Mr. Simpson Noakes and Mr Samuel Monckton White. Mr. Noakes was one of the oldest members of the Society, having been elected at the second meeting, in February, 1875. He was well known and much respected at Bushey, where he resided for forty years. He died at the advanced age of 84. Mr. Larkin has entertained the Society at Delrow, Aldenham, and Major Solly at Serge Hill, Bedmond; Mr. Monckton White has read papers before the Society and frequently lent his oxy-hydrogen lantern to illustrate lectures at the meetings at

St. Albans; and Mr. Mann, who was an authority on hawks and hawking, and kept a mew of hawks at Hyde Hall, Sawbridgeworth, contributed notes on birds to our ornithological recorders.

The census of the Society at the end of the years 1896 and 1897 was as follows:—

	1896.	1897.
Honorary Members	17	17
Corresponding Members	3	3
Life Members	48	46
Annual Subscribers	152	149
	220	215

The following lectures or papers have been read or delivered at Watford during the year:—

Jan. 26.—The Röntgen or "X" Rays; by Thomas Mansell, F.R.M.S., F.R.P.S.

Feb. 26.—Anniversary Address — Serpents and Umbrellas; by the President, Arthur Stradling, M.R.C.S., F.Z.S.

March 23.—Report on the Rainfall in Hertfordshire in the Year 1896; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., etc.

—— Notes on some Plants collected in Hertfordshire by Miss Maria Ransom, 1838–1840; by James Saunders.

—— Notes on Birds observed in Hertfordshire during the Year 1896; by Alan F. Crossman, F.L.S.

—— On some Roman Coins found at Brickendonbury, Hertford; by Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., Treas.R.S., V.P.S.A., etc.

April 30.—Climatological Observations taken in Hertfordshire in the Year 1896; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

—— Report on Phenological Phenomena observed in Hertfordshire during the Year 1896; by Edward Mawley, Pres.R.Met.Soc., F.R.H.S.

—— Notes on Lepidoptera observed in the Neighbourhood of Watford in the Year 1896; by S. H. Spencer, Jun.

Dec. 14.—A Visit to Canada; by John Hopkinson, F.L.S., F.G.S., Assoc.Inst.C.E., etc.

The following have been read at St. Albans:—

April 6.—The Earthquake of the 17th of December, 1896, as it affected the County of Hertford; by Herbert George Fordham.

—— Meteorological Observations taken at The Grange, St. Albans, during the Year 1896; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

—— The Climate of St. Albans, deduced from Meteorological Observations taken during the Ten Years 1887–1896; by John Hopkinson.

—— Water-Levels in the Chalk near Royston; by Harold Warren, Assoc.M.Inst.C.E.

Dec. 8.—British Parasitic Flowering Plants, with a List of the Species; by James Saunders.

The following Field Meetings were held during the year:—

March 19.—Tyler's Hill, Chesham.
April 24.—The Valley of the Bourne, Boxmoor.
May 1.—Abbot's Ripton and Huntingdon.
—— 22.—Aston and Bennington.
—— 29.—Kew Gardens.

June 12.—Sopwell, St. Albans.
—— 19.—Zoological Museum and Tring Park, Tring.
Oct. 23.—Cassiobury Park, Watford.

The Society is indebted to the Earl of Verulam for hospitality kindly afforded at the Field Meeting at Sopwell, St. Albans; to Mr. A. P. Pickering for permission to visit his private grounds at Bennington Lordship; to the Earl of Essex and Sir Matthew White Ridley for permission to visit the Swiss Cottage woods in Cassiobury Park and the private grounds adjoining Cassiobury House; and to the Honourable Walter Rothschild for permission for his museum at Tring to be visited on a Saturday, and Mr. E. Hartert for showing the members over the Museum.

Three parts of the ninth volume of the present series of the Society's 'Transactions,' containing 124 pages and four plates, with several other illustrations, have been published during the year, and the volume will be completed in three more parts, containing the proceedings of the last two sessions, and the title-page, index, etc., to the volume. Donations towards the cost of illustrations have been received from Mr. George Pearson, of Brickendonbury (£5), Mr. H. G. Fordham (10*s*.), and Mr. Harold Warren (10*s*.).

Numerous donations to the Library have been received during the year, the most important being the splendid publications of the United States Geological Survey and Department of Agriculture, and the second edition of Sir John Evans' 'Ancient Stone Implements, Weapons, and Ornaments of Great Britain,' presented by the author.

The funds of the Society are not in such a satisfactory state as might be wished, the expenditure having exceeded the receipts, but this would not have been the case if all the subscriptions for the year and arrears of former years had been paid. It is scarcely possible to effect any economy without curtailing the useful work of the Society. The only heavy item in the expenditure is the cost of the 'Transactions,' but it should be borne in mind that the receipt of the Society's publications is the only benefit which the great majority of the members receive for their subscriptions. To increase the number of members seems to be much the best way out of the difficulty. It would suffice if one member in every five were each year to gain a recruit, and as, out of the ten elected last year, five were obtained by one member (your senior Secretary), this should surely be an easy matter.

There is one exceptional item in the year's expenditure which should be referred to, and that is the purchase of an oxy-hydrogen lantern and lantern-microscope, by the use of which, in illustrating lectures, it is hoped that our meetings will be rendered more attractive than would otherwise be the case. Ordinary microscopic slides can be shown as well as lantern-slides.

INCOME AND EXPENDITURE FOR THE YEAR 1897.

Dr.	£	*s.*	*d.*
To Balance from 1896	1	17	8
,, Entrance Fees	3	10	0
,, Subscriptions for 1892	0	10	0
,, ,, ,, 1893	0	10	0
,, ,, ,, 1894	1	0	0
,, ,, ,, 1895	1	0	0
,, ,, ,, 1896	9	0	0
,, ,, ,, 1897	42	10	0
,, ,, ,, 1898	14	0	0
,, Life Composition Fee	5	0	0
,, Donations towards cost of Illustrations	6	0	0
,, Dividends on £130 India 3 per cent. Stock	4	17	6
,, Sale of Publications ('Flora of Hertfordshire' 17*s.* 6*d.*; 'Transactions' 18*s.* 2*d.*, less expenses)	1	15	8
,, Balance due to Treasurer	7	9	10
	£99	0	8

Cr.	£	*s.*	*d.*
By Printing and Illustrating 'Transactions'	56	12	7
,, Miscellaneous Printing	5	5	0
,, Expenses of Meetings	6	1	9
,, Library Expenses	6	4	4
,, Oxy-hydrogen Lantern and Lantern-microscope	6	0	0
,, Salary of Assistant	5	0	0
,, Postages	11	9	1
,, Stationery and Sundries	1	15	5
,, Fire Insurance	0	12	6
	£99	0	8

Amount invested in the purchase of £130 India 3 per cent. Stock . . . . £126 15*s.* 6*d.*

Audited and found correct this 19th day of February, 1898, { ARTHUR P. BLATHWAYT, ALFRED E. COX.

Additions to the Library in 1897.

Presented.

Baxendell, J. Fernley Observatory, Southport. Report and Results of Observations for the Year 1896. Meteorological. 4to. Southport, 1897 . . .	*The Author.*
British Association for the Advancement of Science. Report for 1896 (Liverpool). 8vo. London, 1897 .	*The Association.*
British Museum (Natural History). Guide to the Fossil Mammals and Birds. 8vo. London, 1896 .	*Trustees of British Museum.*
———. Guide to the Fossil Reptiles and Fishes. *Ib.*	,,
———. ——— Invertebrates and Plants. *Ib.* . .	,,
Christy, Miller. *Primula elatior* in Britain. (*Journ. Linn. Soc., Botany*, 1897)	*Mr. W. Whitaker.*
Evans, Sir John. The Ancient Stone Implements, Weapons, and Ornaments of Great Britain. 2nd. ed. 8vo. London, 1897	*The Author.*
Ormerod, Eleanor A. Report of Observations of Injurious Insects and Common Farm Pests during the Year 1896. 8vo. London, 1897 . . .	*The Authoress.*
Symons, G. J. (Ed.). Monthly Meteorological Magazine. Vol. xxxii. 8vo. London, 1897	*The Editor.*
Whitaker, W. Address to Section 3 (Chemistry, Meteorology, and Geology), Sanitary Institute, Leeds, 1897. 8vo. London, 1897	*The Author.*

Received in Exchange.

American Museum of Natural History. Report for the Year 1896. 8vo. New York, 1897.

———. Bulletin. Vol. viii. 8vo. New York, 1896.

Bath Natural History and Antiquarian Field Club. Proceedings. Vol. viii, part 4. 8vo. Bath, 1897.

Boston (U.S.A.) Society of Natural History. Proceedings. Vol. xxviii. 8vo. Boston, 1896.

Bristol Naturalists' Society. Flora of Bristol Coal-Fields. Edited by J. White. 8vo. Bristol, 1897.

Cardiff Naturalists' Society. Transactions. Vol. xxvii, part 2. 8vo. Cardiff, 1897.

Croydon Microscopical and Natural History Club. Transactions, 1897. 8vo. Croydon, 1897.

Edinburgh. Royal Physical Society. Proceedings. Session 1895–96. 8vo. Edinburgh, 1896.

Glasgow Geological Society. Transactions. Vol. x, parts 1 and 2. 8vo. Glasgow, 1895–96.

——— Natural History Society. Proceedings. Vol. iv, part 3. 8vo. Glasgow, 1897.

———, Philosophical Society of. Proceedings. Vols. xxvi and xxvii. 8vo. Glasgow, 1896–97.

London, Geological Society of. Abstracts of the Proceedings. Session 1896–97. 8vo. London, 1897.

———, ———. Catalogue of Geological Literature added to the Library during the Year 1896. 8vo. London, 1897.

———: Geologists' Association. Proceedings. Vol. xv, parts 1–5. 8vo. London, 1897.

———. Quekett Microscopical Club. Journal. Vol. vi, Nos. 40, 41. 8vo. London, 1897.

———. Royal Meteorological Society. Quarterly Journal. Vol. xxiii. 8vo. London, 1897.

———. ———. Meteorological Record. Vol. xvi, Nos. 59, 60. Vol. xvii. 8vo. London [1896–97].

London. Royal Microscopical Society. Journal. New Series. [Vol. viii,] part 6. Vol. ix. 8vo. London, 1896–97.

Manchester Field Naturalists' and Archæologists' Society. Report and Proceedings for the Years 1895 and 1896. 8vo. Manchester, 1896–97.

———— Geographical Society. Journal. Vol. xii, vol. xiii, parts 1–9. 8vo. Manchester, 1897.

———— Geological Society. Transactions. Vol. xxv. 8vo. Manchester, 1897.

———— Literary and Philosophical Society. Memoirs and Proceedings. Vol. x, part 4. 8vo. Manchester, 1896.

———— Microscopical Society. Report, 1896. 8vo. Manchester, 1897.

Microscopy and Natural Science, International Journal of. Vol. vii. 8vo. London, 1897.

New York State Library. Additions, No. 3. September, 1894. 8vo. Albany, 1897.

————. Annual Report for the Year 1894. 8vo. Albany, 1897.

New York State Museum. Annual Report. Vols. i and ii, for the Year 1894. 8vo. Albany, 1897.

Norfolk and Norwich Naturalists' Society. Transactions. Vol. vii, part 3. 8vo. Norwich, 1897.

Northamptonshire Natural History Society and Field Club. Journal. Vol. ix, Nos. 65–68. 8vo. Northampton, 1896.

Philadelphia Academy of Natural Sciences. Proceedings. 1896, parts 1–3. 8vo. Philadelphia, 1897.

Rugby School Natural History Society. Report for the Year 1896. 8vo. Rugby, 1897.

Smithsonian Institution (U.S.A.). Annual Report for 1894. 8vo. Washington, 1896.

————. Annual Report for 1895. *Ib.*

Somersetshire Archæological and Natural History Society. Proceedings, 1896. Vol. xxii. 8vo. Taunton, 1897.

United States Department of Agriculture. Farmers' Bulletin, No. 54.—Some Carnivorous Birds. 8vo. Washington, 1896.

————. North American Fauna, No. 13. *Ib.* 1897.

————. Year Book for 1896. *Ib.* 1897.

United States Geological Survey. Annual Report for 1895–96. Part 1, Director's Report. Part 2, Economic Geology. Part 3, Metallic Products, etc. (3 vols.) 8vo. Washington, 1896.

————. Bulletin. No. 87.—Synopsis of American Fossil Brachiopoda; by C. Souchert. No. 127.—Catalogue and Index of Contributions to North American Geology, 1752–1891; by N. H. Darton. No. 130.—Bibliography and Index of North American Geology, Palæontology, Petrology, and Mineralogy for 1892 and 1893; by F. B. Weeks. No. 135.—Do. for 1894. No. 136.—The Ancient Volcanic Rocks of South Mountain, Penn.; by Florence Bascombe. No. 137.—The Geology of the Fort Riley Military Reservation, Kansas; by R. Hay. No. 138.—Artesian Well Prospects in Atlantic Costal Plain Region; by N. H. Darton. No. 139.—The Geology of the Castle Mountain District of Montana; by W. H. Weed and L. V. Pearson. No. 140.—Report of the Division of Hydrography for the Year 1895; by F. H. Newell. No. 141.—The Eocene Deposits of the Mid-Atlantic Slope in Delaware, Maryland, and Virginia; by W. H. Clark. No. 142.—Brief Contributions to the Geology and Palæontology of N.W. Louisiana; by T. W. Vaughan. No. 143.—Bibliography of Clays and Ceramic Arts; by J. C Branner. No. 144.—Moraines of Missouri, Coteau, and other Attendant Deposits; by J. E. Todd. No. 145.—The Potomac Formation in Virginia; by M. Fontaine. No. 146.—Bibliography and Index of North American Geology, etc., for 1895. No. 147.—Earthquakes in California in 1895; by C. D. Perrine. No. 148.—Analyses of Rocks; by F. W. Clark and W. F. Hillebrand. 8vo. Washington, 1896. (For Nos. 123–126, 128, 129, 131–134, see Trans., Vol. IX, p. lxii.)

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204th Ordinary Meeting, 18th March, 1898, at St. Albans.

F. W. Silvester, Esq., in the Chair.

The following lecture was delivered:—

"A Visit to Canada and the Falls of Niagara." By John Hopkinson, F.L.S., F.G.S., Assoc. Inst. C.E., Hon. Sec.

A repetition, by request, of the lecture delivered at Watford on 14th December, illustrated by lantern-slides.

205th Ordinary Meeting, 22nd March, 1898, at Watford.

William Whitaker, B.A., F.R.S., Pres. G. S., Assoc. Inst. C.E., President, in the Chair.

Mr. Henry John Ryman was elected a member of the Society.

The following papers were read:—

1. "The Palæolithic Deposits at Hitchin and their Relation to the Glacial Epoch." By Clement Reid, F.L.S., F.G.S. Communicated by the President. (*Transactions*, Vol. X, pp. 14–22.)

Diagrams showing the strata passed through in borings at Hitchin were exhibited by Mr. Reid in illustration of his paper, and also collections of flint implements and fossil bones found in the Hitchin lake-bed and lent by Mr. William Ransom.

The President alluded to the quantity of remains of plants found in the Hitchin lake-bed by Mr. Reid, who, he said, was a great authority on fossil plants. He also remarked that it was a curious fact that the bones found were all of larger animals than man.

2. "Report on the Rainfall in Hertfordshire in the Year 1897." By John Hopkinson, F.L.S., F.G.S., Assoc. Inst. C.E. (*Transactions*, Vol. X, pp. 23–32.)

The President remarked that all the springs were going down, and he thought that the question of water-supply would in a short time be a very serious one.

Mr. Hopkinson said that this was due to the small amount of rain which had fallen in the Winter. As a rule the second half of the year was much the wetter of the two, but the first half of last year had 56 per cent. of the year's fall, while the second half had only 44 per cent. The last quarter had only 18 per cent., and this year up to the present time very little rain had fallen.

3. Report on the Conference of Delegates to the British Association at Toronto in 1897. By John Hopkinson, F.L.S., F.G.S., etc., Hon. Sec.

Having acted as your Delegate to the Toronto meeting of the British Association, it is my duty to present to the Society a report on the proceedings at the Conference of Delegates of the Corresponding Societies held at that meeting.

The meetings of the Conference were held in the University of Toronto on the 19th and 23rd of August. The Corresponding Societies' Committee of the British Association was represented at each meeting by Professor Meldola, F.R.S., Chairman, and by your Delegate, who had been appointed Secretary of the Conference, and at the second meeting also by Sir John Evans, K.C.B., F.R.S., President of the Association.

First Meeting.

Unions of Natural History Societies.—The Chairman, Professor Meldola, F.R.S., said that at the Liverpool Conference the question of federation amongst the local Natural History Societies of Great Britain had been referred to the Corresponding Societies Committee, and the action of the Committee had been embodied in the Report which the Secretary would now read.

Your Delegate then read the Report of the Corresponding Societies Committee, which gave the results of an attempt made to obtain the opinions of local Scientific Societies on the question of federation. Extracts from this Report which may be of interest to our members follow.

To a letter addressed to 124 Societies there were 34 replies, which may be thus arranged:—Belong to Unions already, 9; in close touch with a Union, 1; prevented by circumstances from joining Unions, 2; undecided, 4; generally favourable to Unions, 9; unfavourable in their own cases, 9: total, 34.

The answers received from Societies which already belong to a Union, or are in close touch with one, call for no remark. The two Societies prevented by circumstances from joining Unions are the Cambridge Philosophical Society and the Marlborough College Natural History Society. In the replies from the four Societies classed as "undecided," perhaps the most significant remark is that economy of energy might be dearly purchased by loss of enthusiasm, "a deadening uniformity" resulting from union. Of the nine Societies generally favourable to Unions, two only, the Hertfordshire Natural History Society and the Leicester Literary and Philosophical Society, sent definite, detailed plans of what they proposed to accomplish in their own localities. And a third, the Essex Field Club, stated that it was in communication with the Norfolk and Norwich Natural History Society with the view of establishing some degree of co-operation between the two Societies in the future. The others contented themselves with the remark that union was a step in the right direction, or with some other phrase expressing vague approval.

The replies received from the Societies classed as "unfavourable in their own cases" vary very much as to their approval of federation in the abstract. All these Societies are Corresponding Societies, and have counties or other large areas as their spheres of work.

Judging from the answers received, it would appear that Societies having a whole county or some district of similar size as their sphere of operations are usually indifferent, or averse, to union with adjacent counties or districts. Members of such Societies do not generally feel a strong local interest in larger areas, and at the same time they do not need the help of other Societies in the publication of their Transactions. On the other hand, experience shows that a large number of the smaller local Societies are associations rather for lectures and excursions than for local scientific work, and the brief annual reports which they issue are of little interest, except to their own members. Consequently they also are uninterested in questions about federation.

Two Societies, which once belonged to the Midland Union, express a preference for Unions like the Yorkshire Naturalists' Union. The great advantage possessed by that federation lies, however, in the fact that all its members, though they may live as far apart as any members of the Midland Union once did, have the common feeling of being Yorkshiremen.

Some disappointment may be felt at the slightness of the interest manifested in federation. But it may be hoped that many Societies which are more or less averse to any close federation with neighbouring Associations have, nevertheless, had their thoughts profitably directed towards the attainment of a much greater amount of mutual co-operation and assistance than at present prevails.

The Chairman said that there were great differences of opinion with regard to federation, but he thought that much good might

result from such a scheme as the grouping of counties for occasional meetings of their local Societies, if for no other purpose than to avoid duplication of work. By the proceedings of local Societies being collected into one publication, diffuseness would be avoided, and the money spent by individual Societies upon printing might profitably be diverted into other channels.

Professor Herdman said that many scientific men in provincial towns like Liverpool had thought a great deal about this question in recent years, but every attempt made by the Liverpool Geological and Biological Societies to decide upon a line of action with other local Societies had ended in failure. Office-bearers were, as a rule, opposed to federation.

Dr. H. R. Mill stated that the East of Scotland Union of Naturalists' Societies was very successful, all the members of the federated Societies having the same feeling of local patriotism, and that the Perthshire Society of Natural Science was one of the best of these local Societies, its museum being one of the sights of Perth. The Kirkcaldy Natural History Society was also one of the best in the Union. These Societies meet in different towns each year, have joint excursions, and are so satisfactorily related as to give him great faith in the importance of union.

Mr. G. P. Hughes said that the Berwickshire Naturalists' Club was doing first-class work in archæology and natural history, but he did not think that federation could be accomplished in the counties of England north of Yorkshire and Lancashire, the area being so large.

The Rev. J. O. Bevan spoke in favour of joint meetings of the Woolhope Naturalists' Field Club, the Cardiff Natural History Society, and the Caradoc and Severn Valley Field Club. It seemed to him that the British Association possessed the best means of leading provincial Societies into union.

Professor Weiss said that the Manchester Microscopical Society was willing to federate with some of the other local Societies, and found a desire for affiliation, but a difficulty in carrying it out, many Societies thinking that they would lose more or less of their identity in union.

Mr. R. E. Dodge (New York) mentioned the Scientific Alliance of New York as having accomplished something by union, the announcement of meetings being satisfactorily made in the Bulletin of the Alliance, and the libraries of the different Societies being kept together in one building. At Washington the Joint Commission, on which all the Government scientists are represented, was formed on similar lines.

Dr. Henry M. Ami (Ottawa) said that this question had also arisen in Canada. For two years they had been attempting to bring about the union of the Ottawa Literary Society and the Ottawa Field Naturalists' Club. There was a movement on foot in Canada to form a Canadian Academy of Science, in which geology, botany, zoology, and microscopy would be represented.

Your Delegate said that there were various ways in which federation could be carried out, which he might roughly group under three heads—amalgamation, union, and co-operation with representation. He instanced the Caradoc and Severn Valley Field Club as a good example of the benefit of amalgamation, a strong field club doing good local work, and publishing the results, having been formed by the coalition of two Societies which were struggling for existence. The advantages of union without amalgamation were well illustrated by the Yorkshire Naturalists' Union, each Society composing it being quite independent, but meeting together at an annual congress in different Yorkshire towns. Amongst its members were several Yorkshiremen, such as himself, not now residing in the county nor being members of any of the affiliated Societies. The publications of the Union were devoted to the meteorology, geology, botany, and zoology of Yorkshire. Under the third heading might be cited the present Conference, or such Societies represented as were co-operating with Committees of Research of the British Association; while there were several intermediate links between the three grades of union. Federation, therefore, did not imply sacrifice of individuality.

Second Meeting.

The Study of Life-histories.—Professor Miall, F.R.S., made the following remarks :—

"My appearance here this afternoon is due to the fact that Professor Meldola and myself, who visited Niagara on Saturday, fell into conversation upon the work of the local Societies. Your Chairman thought it might be of some use to bring before this meeting, in the form of suggestions, as practical as possible, some portions of our talk at Niagara Falls. The local Societies carry on a great variety of work, but upon that and upon the special influence of those Societies with regard to scientific investigation, I do not intend to offer any remarks. I desire only to bring before you one particular line of inquiry which may be of interest to you, and from which we may perceive how one side of natural history is, as it seems to me, unjustly neglected. I refer to the study of life-histories. We study animals and plants in a great variety of forms; we compile statistics of them, and we collect specimens; but the central point of interest, the life-history, is neglected.

"It may be thought that this study of life-histories is not specially suited for the amateurs who compose a large part of the local Societies. It cannot be denied that the work is hard and has special difficulties connected with it, for to prosecute it in an adequate manner involves some knowledge of anatomy and physiology, and also some acquaintance with the problems of development as well as a considerable power of observation and much enthusiasm. These certainly appear to be large demands, but we cannot expect to get any scientific results of real importance which are not procured at the cost of much labour. The things which lie upon the surface and are easily got at are, as a rule, in

the present development of science, not of very great value. If we aim at achieving real scientific results we must expect to have to pay for them both with our time and with our labour.

"If there be anyone here who may think of devoting himself to the study of life-histories, I need hardly say that he has an abundant choice of subjects, even in so narrow and so well worked a country as England. I will ask your permission to take a run over that department of natural history with which I have of late years occupied myself. I refer to the study of insects. Anyone who has occupied himself with promoting the scientific study of insects will, I think, agree with me when I say that almost everything still remains to be done. The insects have been collected and classified, but with rare exceptions their life-histories are still unknown. Let me instance the Lepidoptera and Coleoptera, for the simple reason that they are better known than the rest. We know well their external forms or shapes; the stages of many have been recorded and drawn; and along with these external features we know something about their food-plants, mode of life, and so on; but how their mode of life and peculiarities of structure are interrelated we know not. I think it is a reproach to the naturalists of our generation that they are content to leave the higher knowledge of insects and devote their whole attention to mechanical details.

"As a type of what I am dealing with, let me refer you to the common Diptera. I do not think that more than a dozen out of the vast number of these insects have been thoroughly investigated. It seems that 200 or 300 have been studied, at least superficially, and of these we know more or less; but they are among many thousands of which it seems that we are practically in complete ignorance. What, then, can we expect to learn about such a subject as this unless we are prepared to meet difficulties and incur the cost of time and labour? Here is a vast and important field inviting the attention of naturalists; and when we consider the number of enthusiastic naturalists scattered, not only over our own, but also over every other country, we might surely expect most important results if this business were taken seriously in hand.

"As to the methods of inquiry, let me suppose that any one of you intends to take up live natural history. I should recommend him to study the things which are commonly found round about him; to procure those animals which he is accustomed to see again and again every day, and which he will not have to go a mile or two to procure, say from the nearest stream if not too far away. Then as to the helps which exist, there is a literature of this subject, but one difficulty is that most, if not all, of this literature is written in a foreign language. Malpighi wrote in Latin, and Swammerdam in Dutch, Réaumur in French, while Boerhaave translated Swammerdam's work into Latin.

"It is singular that so great a lapse of time has taken place with little addition to the literature of this subject, since these writers are of the seventeenth and eighteenth centuries. The work which

they carried forward with so much promise of high achievements was allowed to fall into neglect. There are a few exceptions, but, generally speaking, from the commencement of the century up to the present time the subject seems to have fallen into almost complete abeyance.

"To incite beginners to undertake this special work of the study of life-histories, I think that something might be done if we were to put before them a single example of a common insect worked out with some degree of detail. If that were done in England it would get over the difficulty felt by naturalists who have not made acquaintance with a foreign language. We have hardly any examples of life-histories worked out and presented to us in a thoroughly acceptable form. This difficulty seems to me so considerable that I am now trying to draw up such a life-history of the Chironomus, or blood-worm, which is everywhere accessible. It is one of the most instructive insects known to naturalists, and in twelve months I hope to have its life-history ready for the use of the student.

"But it is not enough merely to have a book put into the hands of students; they must know how the actual work of observation is done. It might be possible to pick up from among the members of the Corresponding Societies in various parts of England an enthusiastic party of young men and show them how particular things are done. For instance, how to capture certain kinds of insects, how to study them anatomically, how to disclose the embryonic development and the inner changes which accompany metamorphosis. Let me suppose that out of the members of the local Societies situated within convenient distance of the city of Leeds, where I have my laboratory, twelve should agree to assemble some time next summer, say in July, and take up the work which I have proposed, each to bring his own microscope, if he has one. I will then undertake to go through a quite elementary course of training on the Chironomus, its life-history and its development. I think I can undertake to initiate such a party of investigators into a useful method of carrying on the study of life-histories, and I think they will carry home with them, from a short course of study, a determination to pursue the work. We could then try the experiment in another district, London for instance; and I should also be glad to do anything by way of correspondence to further this study.

"If we should succeed in carrying out this plan it might lead to a revival of the study of natural history in our country. Each student might turn into a centre of infection when he went home, and spread the virus through his brother naturalists. Let us look forward to such a revival, and if the suggestions which I have made should command for this subject the sympathy it deserves, we may realize a bright future for this important branch of knowledge."

Sir John Evans expressed the indebtedness of the meeting for the practical suggestions of Professor Miall. He hoped that those

present would realize the desirability of extending the work of the local Societies in the direction indicated. Listening to Professor Miall's plea for the study of the life-histories of insects, he recalled the observation of a great ancient authority, Pliny, who said that the nature of things is nowhere more complete than in the least (*Cum natura rerum nusquam magis quam in minimis tota sit*), a remark which he thought foreshadowed the results discovered by naturalists by means of the microscope in modern times.

The Chairman said that he would like to express the hope that when Professor Miall's suggestions had been circulated among the members of the Corresponding Societies, and his ideas had borne fruit, they would have the pleasure of hearing, at another Conference, of his students having achieved valuable work under his tutorship.

Museums of Canada.—Dr. Ami then read a paper "On the State of some of the Principal Museums of Canada and Newfoundland," which was ordered by the General Committee to be printed *in extenso* in the Report.

The Chairman said that he could not help being struck with the great wealth of material existing in Canada. Englishmen must feel a certain amount of regret that the museum question is not taken up with more earnestness in their own country. Their provincial museums only existed with much difficulty, and were altogether dependent upon private bounty in carrying on their existence. Anyone who visits many of the local museums in England must see that the museum question has not taken that prominent part in public opinion which it ought to do. Dr. Ami has collected a vast amount of information of great value. There must be in the museums of Canada much valuable material in the way of types, and students in all parts of the world would be the gainers if it were widely known where those types were to be found.

Your Delegate remarked that he was specially interested in the museum question at the present time, for he and other members of the Hertfordshire Natural History Society, including Sir John Evans, were now endeavouring to raise sufficient money to build and endow a museum for Hertfordshire, for which Earl Spencer had granted an ample site at St. Albans. They had already been promised about £1,500. A temporary museum had been opened at St. Albans, and he felt sure, from their success in obtaining objects of local interest for it, that if the money required (at least £2,000) could be raised, an interesting and valuable collection would be got together. He feared that Dr. Ami's paper was too long to be published in the Report of the Conference of Delegates, but as the Conference stands upon the same footing as any Section of the Association, it was empowered to suggest to the Committee of Recommendations that this paper should be printed *in extenso* in the Report of the Association, and he moved that such a request be made.

This was carried unanimously.

Ethnographical Survey.—Professor Haddon said that it seemed to him that, while the local Societies properly spend a great deal of time on natural history, they neglect the study of man, who is an animal, and deserves to be studied as thoroughly as the lower animals Local Societies might well undertake a survey of the ethnography of their own districts. He would be sorry to draw students away from the study of other branches of natural history, but he thought that there must be many members of the local Societies who did not study the fauna, the flora, or the geology of their locality, but would be interested in ethnographical work of some kind. There are several anthropological investigations which could be attempted almost anywhere. Besides observations on the colour of the hair and eyes, the stature, the shape of the head, and other physical characters, the customs and beliefs of the people and their folklore should be studied. As examples, mention need only be made of local customs on particular days, or the numerous and very interesting singing games of children. These might seem to be trifling matters, but many such customs and games are the only records we have left to us of the religious rites and social customs of our ancestors, and therefore they are by no means to be despised. It would also be advisable for the local scientific and photographic Societies to interest their members in depicting the geology, natural history, and ethnology of their district, the latter especially. Many opportunities for the study of British anthropology are vanishing or becoming modified, just as surely as are corresponding details in the islands of the Pacific.

Professor Haddon desires that the following be added to his remarks:—The length of the schedule prepared by the Committee for the Ethnographical Survey of the British Isles having deterred some from undertaking to make observations and measurements, it has been decided to issue an alternative, simpler one, which will probably take the following form:—

Name	Age	District from which Parents come	Colour of		Stature	Weight	Head		Nose	
			Hair	Eyes			length	breadth	length	breadth

Other subjects brought before the Conference were the appointment of a Committee for obtaining a collection of Canadian geological photographs; the investigation of green oysters and the causes which may account for the colour; and the importance of the accurate use of generic and specific names in the publications of local Societies, and of giving full and accurate descriptions of new species.

206TH ORDINARY MEETING, 26TH APRIL, 1898, AT WATFORD.

WILLIAM WHITAKER, B.A., F.R.S., Pres.G.S., Assoc.Inst.C.E., President, in the Chair.

Mr. J. A. Bell, Hamsterly, Watford, was proposed for membership of the Society.

The following papers were read:—

1. "Meteorological Observations taken in Hertfordshire in the Year 1897." By John Hopkinson, F.L.S., F.G.S., Assoc.Inst.C.E. (*Transactions*, Vol. X, pp. 49–60.)

2. "Report on Phenological Phenomena observed in Hertfordshire during the Year 1897." By Edward Mawley, Sec.R.Met.Soc., F.R.H.S. (*Transactions*, Vol. X, pp. 61–67.)

3. "Notes on Birds observed in Hertfordshire during the Year 1897." By Alan F. Crossman, F.L.S. (*Transactions*, Vol. X, pp. 33–43.)

MR. HENRY LEWIS said that some years ago Mr. James Lough found at St. Albans a robin's nest in which there was a young cream-coloured robin. He remarked that hawfinches were largely on the increase, but that he now seldom saw goldfinches on Bernard's Heath, owing to birdcatchers taking them. Linnets were very numerous there at one time, but now they were comparatively rare. He had seen a bird shot in the neighbourhood of Hertford which he thought was a Californian quail, and also a pheasant with feathers of a peculiar dark blue colour.

THE PRESIDENT said that we owed a considerable number of records to the presence of reservoirs, birds which would not otherwise visit the county frequenting them and building on their margins. Of late years gulls had come inland to a much greater extent than before, the extraordinary encroaching habits they were developing being notable in St. James' Park, which they seemed to think belonged to them.

MR. HOPKINSON, replying to a question, said that there were at least 210 species of birds recorded for the county, which he thought was a very good record. His experience with regard to nightingales last year was that they were exceedingly plentiful, but he had not heard the cuckoo so often as usual.

MR. LEWIS corroborated the presence of an unusual number of nightingales last year, and remarked that they were usually in full song in the neighbourhood of St. Albans by the 17th of April.

The following short notes were then read:—

1. "A Meteor seen at Kensworth." By Miss S. Grace Jones. (*Transactions*, Vol. X, p. 68.)

2. "The Fly-Orchis at Cheshunt." By George Paul. (*Transactions*, Vol. X, p. 68.)

3. "An Egg within an Egg." By Sir John Evans, K.C.B., D.C.L., F.R.S. (*Transactions*, Vol. X, p. 68.)

Bye Meeting, 30th April, 1898.

NATURAL HISTORY MUSEUM, SOUTH KENSINGTON.

The members first inspected objects illustrative of British Natural History, and mimicry, albinism, melanism, etc., in the Entrance Hall, especially the recent additions, and then proceeded to the Geological Galleries, where Dr. Henry Woodward, F.R.S., Keeper of Geology, kindly showed and explained some additions recently made to the geological collections, subsequently taking the party to the new room, not then opened to the public, in which whales and other Cetaceans are being set up, and explaining the most interesting features connected with them.

Field Meeting, 7th May, 1898.

ASHRIDGE PARK AND GARDENS.

A numerous party assembled in front of Ashridge House at half-past 3 to visit the gardens, by the kind permission of Earl Brownlow. Much the larger number were cyclists, a few drove, and others arrived on foot. Mr. Edward Mawley acted as Director, and the head-gardener, Mr. Lowe, accompanied the party through the gardens. The conservatories, greenhouses, etc., were also visited.

Ashridge House is one of the finest old mansions in the county, and stands in a beautiful park, one of the few in which are kept both red and fallow deer. On its site was once the palace of Edmund Plantagenet, son of Henry the Third, who founded in the year 1283 a Monastery here for the order of "Bonhommes." Queen Elizabeth received a grant of the confiscated Monastery in 1552, and resided here as a Princess. In her reign the Collegiate Church was destroyed, but the great hall and cloisters survived until 1800, when they were replaced by the mansion erected by Wyatt for the Earl of Bridgewater, nothing now remaining of the old building but the crypt.

The gardens are tastefully laid out and adorned with fine old trees, those of most interest being pointed out by Mr. Mawley. Trained to the battlements of the mansion are magnificent evergreen magnolias which flower profusely during the summer; the boles of several measure a yard in circumference. The wide-spreading yew-trees close by have no doubt stood for centuries. On the eastern side of the mansion, near the Italian garden, is a row of beautiful old lime-trees, growing to a great height and having their branches trained to form a double avenue; and on the western side is a row of elms which have suffered much from the storms of recent years, but some of the older trees which remain have trunks 20 feet in circumference 6 feet from the ground. There are some handsome evergreen oaks, and near them, in the centre of the lawn, is a splendid oak planted by Queen Victoria when 4 years of age (in 1823).

Near the winter garden, which is planted with many choice evergreens and other shrubs, are fine examples of *Pinus nobilis*,

and also two lime-trees which give a welcome shade during the summer, their branches spreading out over a large area. The Japanese arbor-vitæ (*Thuiopsis dolabrata*) is believed to be the best example in this country. Well-grown trees of *Wellingtonia gigantea* form an avenue 500 yards long.

Rhododendrons thrive well, and they are grown on a very large scale, all the leading varieties being included. And here are also to be found the largest sweet-scented verbenas (*Aloysia*) in this country.*

The finest trees in the park are beeches, for which the calcareous soil is most favourable. In fact, there are so many noble examples of the erect-growing beech that the park is celebrated for them.

On leaving the gardens the party proceeded to Frithsden, a distance of two miles through the park, and, after having tea there, on the hill-side just under Frithsden Copse, dispersed.

Field Meeting, 14th May, 1898.

AYOT GREEN AND HATFIELD HYDE.

This was a joint meeting with the Geologists' Association under the direction of Mr. Hopkinson and Mr. A. E. Salter. Most of the members of the Herts Society cycled, while the members of the Geologists' Association came by train to Ayot Station.

The brickfields near the station were first visited, and here Mr. Salter gave an account of the physiography of the district. He stated that Ayot Green was situated on high ground—from 380 to 406 feet above sea-level—between the valley of the Lea and that of its affluent the Mimram, the Lea rising near Houghton Regis, over 400 feet above the sea, and flowing through Luton before it enters Hertfordshire, and the Mimram first appearing as a pond at Whitwell near St. Paul's Walden, scarcely 300 feet above the sea, and flowing through Welwyn, past Tewin, and into the Lea at Hertford. He then referred to the various gaps in the Chalk downs — the Luton Gap through which the Lea flows, the Hitchin Gap (305 feet), and the Bishop's Stortford Gap (230 feet), the position of these gaps being regarded by him as of great importance in all questions relating to the origin of the drift deposits in the Thames Basin.

He next described the geological structure of the district, stating that Ayot brickfield is situated on one of the many Tertiary outliers, resting on the Chalk, which fringe the Thames Basin on the north and on the south. In most cases, if not all, they are capped by beds of gravel, to the presence of which their preservation may mostly be ascribed. The outliers at Penn and Coleshill between High Wycombe and Amersham, Tyler's Hill or Cowcroft near Chesham, Bennett's End, and Bernard's Heath, St. Albans, on the north-west of the London Basin, are similar examples, and Well Hill is an example of such an outlier occurring on the south.

* For information on these trees and shrubs the Editor is indebted to Mr. Lowe.

Mr. Hopkinson then drew attention to the remarkably straight line formed by the outliers on the north, by means of a strip of paper twelve times as long as it was wide, on which he had drawn nearly all the outliers which extend from Wargrave beyond Maidenhead on the south-west, to Albury near Bishop's Stortford on the north-east, a distance of fifty miles. They are almost exactly in the line of strike of the Chalk, and he referred to the theory that they mark a slight synclinal deflection in the dip of the underlying strata. This line of Tertiary beds now forms the highest land, so it was strange if it owed its preservation from denudation at an early period, as was supposed, to having lain in a hollow in the Chalk. At any rate, the existing outliers were probably fragments of a once more-continuous band, and owe their individual preservation at a later period, and onwards to the present time, to the greater resistance to subaërial denudation offered by the gravel by which they are mostly capped than by the Chalk by which they are surrounded. Most of the outliers east of Datchworth he stated were of the Reading Beds only; the Datchworth outlier, not far from here, and others in a westerly direction had upon these beds the London Clay, though sometimes no more of it than its basement-bed. Here the Reading Beds consist of sands with numerous clayey partings. The Chalk below is piped, and the Tertiary beds above have been irregularly let down, giving them quite a contorted appearance on the north side of the brickfield, while on the south they are overlain by the London Clay, and, although not here seen, he thought it might be inferred that this clay had so far prevented the percolation of water into the Chalk that pipes are absent and the Reading Beds are but little disturbed.

In the basement-bed of the London Clay, teeth of several species of shark and casts of bivalve shells are sometimes to be obtained, but the bed of flint-pebbles in which these occur was nearly all covered up by débris. This is the lowest layer of the basement-bed, but there is another layer of flint-pebbles near the top in which oyster-shells are occasionally found.

Drift gravels, which in one part are very similar in composition to Westleton Shingle, were seen to cover the Tertiary beds, and to have boulder-clay resting upon them; and in Griggs' Wood, a little to the north and on the highest ground in the immediate neighbourhood, a characteristic section of Westleton Shingle was seen, and Mr. Salter pointed out the simple character of its constituents and their similarity to those forming the gravels at South Mimms, High Barnet, and other places on the main mass of the London Clay.

On leaving the brickfield Sherrards Park Wood was entered. The trees were looking their best with the fresh verdure of spring, and the walk of three miles through the wood to the pits near Hatfield Hyde was much enjoyed. Here there is a very large excavation by the side of the Great Northern Railway, exposing a depth of about 42 feet of Glacial deposits, consisting of an upper bed of boulder-clay 12 feet in thickness with much chalk in its lower

part, and containing drifted fossils, and Triassic and other pebbles; about 15 feet of sands with patches of gravel containing similar débris; a lower bed of boulder-clay one foot thick, similar to the upper one; and about 15 feet of ochreous flint-gravel and sand with Triassic quartzites, reposing on disintegrated chalk.

The Rev. G. H. O. Kendall, of Hatfield, who has been investigating this section, met the party here and showed specimens which had been carefully collected from the various layers, one of which, of Carboniferous Limestone, finely striated and showing sections of Crinoid stems, was especially interesting.

Leaving the geologists to continue their investigations, the members of the Hertfordshire Society left for Mill Green, the cyclists riding on to order tea there, and the pedestrians strolling across the meadows. After tea the two societies reunited and were conducted by Mr. Kendall through the woods which fringe the north-west corner of Hatfield Park, crossing the Lea at the point where it is expanded into an ornamental sheet of water; and on arriving at Hatfield the societies again parted, the members of the Geologists' Association being left at the "Red Lion" to the enjoyment of a substantial tea.

Field Meeting, 11th June, 1898.

LATIMER AND CHENIES.

This meeting was held in conjunction with the St. Albans Architectural and Archæological Society, and was under the direction of Mr. William Page, F.S.A., and the Secretaries of the Hertfordshire Natural History Society.

Members of the two societies assembled on the village green of Chenies at 12 noon, most of them having cycled with Mr. Carter from Watford and Mr. Hopkinson from St. Albans, and again at 3, when they were joined by several others.

The little village of Latimer was first visited, the route taken being through the woods, partly along Lady Cheyne's Walk, with a halt for a picnic luncheon on the way, and then by the foot-bridge over the rippling river Chess, which below this point divides Herts from Bucks. The church, dedicated to St. Mary Magdalene, was inspected. It is situated between the present village and Lord Chesham's Park, which now covers the site of the destroyed portion of the once more-extensive village. The church was built in 1841 on the site of a Chapel of Ease dating from before 1213. It was much improved in 1867 by Sir Gilbert Scott, who must have undertaken the work with peculiar pleasure, having spent some of the happiest days of his childhood at Latimer. In his 'Recollections' (1879) he says: "The country there is peculiarly charming, and so wholly different from my own home as to be like a new world. My love of woodland was here transferred from oak woods choked up with hazel and blackthorn, to beech woods through which you may wander without obstruction.

The very wild flowers and wild fruits were different, while the search for chalcedonies and fossils among the flints, with which the woods were bestrewed, afforded amusement to my solitary wanderings and pleasure in showing upon my return what I had found." He also remarks: "The village, which was in two parts —one on the hill and the other below—was very picturesque, with old timbered houses, and a glorious old elm-tree of towering height on the village-green. The upper village is now destroyed, and the whole merged into the grounds. My recollection of the whole district is of a little paradise. The hills, valley, river, trees, flowers, fruit, fossils, etc., all seem encircled in a kind of imaginary halo. I fancy that I never saw such wild flowers, or ate such cherries or such trout as there. There I terminated my childhood, and thence I emerged into the wide world, in the prosaic turmoil of which I have ever since been immersed."

Both Latimer and Chenies formerly bore the name of Iselhamsted, becoming known, from the names of their owners, as Latimer's Iselhamsted and Cheyne's Iselhamsted. Between the two places, near Latimer, but on the south side of the river and therefore in the parish of Chenies, remains of a Roman villa have been discovered, a description of which has been given by the Rev. Bryant Burgess.* A historical account of "Latimers or Latimer" has also been given by him.† The following extract from it, which well portrays the condition of the district in Roman times, is of sufficient interest in relation to our county to reproduce here.

"When this Chiltern district was an almost unbroken forest of beech, the narrow valleys through which the streams (larger then than now) spread fertility and offered pasture for flocks and herds, were chosen by early settlers for their homes. In the days when, built on the bank of the little river Ver, Verulam was a famous Roman city, and some Italian centurion or colonist had built his villa by the stream at Wycombe, and others in the Boxmoor valley and near Hemel Hempstead, a spot close to the stream at Iselhamsted was chosen by one of the same race for a residence of no mean dimensions. With a constant supply of water for the bath from the river Chess, and an abundance of fuel for the hypocaust in the overhanging woods, a villa, or range of buildings, some 200 feet in length, was built to face the morning sun. Coins of the second and third centuries found among its walls suggest that it was inhabited at the time when the Proto-martyr of England was beheaded on the site of St. Alban's Abbey at a distance of only twelve miles."

The ruined church of Flaunden, which is in Herts, was next visited. It has already been described in the report of a previous field meeting.‡ After inspecting it the party returned to Chenies to keep the appointment made to meet those who could not come in the morning. The opportunity of inspecting the Russell Chapel in the Church of St. Michael, by the kind permission of the Duke of Bedford, attracted a considerable number, and so much time was devoted to this, and to a visit to the old mansion near it, now

* "The Roman Villa at Latimer, Bucks," in 'Records of Buckinghamshire,' vol. iii, p. 181 (1867).

† *Ib.*, vol. vi, p. 27 (1887).

‡ 'Trans. Herts Nat. Hist. Soc.,' Vol. III, p. lxiv (1886).

converted into a farm-house, that the intended botanizing expedition in the woods had to be abandoned, and the members dispersed after having tea.

Bye Meeting, 25th June, 1898.

ZOOLOGICAL GARDENS, REGENT'S PARK.

The members of the Society were admitted free into the Gardens by favour of the Zoological Society, and a few passes of admission for their friends were provided by the Director, Mr. Arthur Stradling, F.Z.S. A tour of the gardens was then made under his guidance, and a series of short demonstrations of the most interesting animals, with a description of their habits, etc., was given by him, special attention being devoted to such creatures as are on the verge of extinction, and of which the specimens inspected are probably the last which will be seen.*

207th Ordinary Meeting, 15th November, 1898, at Watford.

William Whitaker, B.A., F.R.S., Pres.G.S., Assoc.Inst.C.E., President, in the Chair.

Mr. J. A. Bell was elected a Member of the Society.

Mr. A. Faulkner and Mrs. Faulkner, The Gables, St. Peter's Park, St. Albans, and Mr. A. G. Pearse, 17, London Road, St. Albans, were proposed for membership.

The following paper was read:—

"The Chadwell Spring and the Hertfordshire Bourne." By John Hopkinson, F.L.S., F.G.S., Assoc.Inst.C.E., Hon. Sec. (*Transactions*, Vol. X, pp. 69–83.)

208th Ordinary Meeting, 13th December, 1898, at Watford.

William Whitaker, B.A., F.R.S., Pres.G.S., Assoc.Inst.C.E., President, in the Chair.

Mr. and Mrs. Faulkner and Mr. A. G. Pearse were elected Members of the Society.

Mr. Robert May Christopher James, Longheath, Watford, and Mr. George Francis Smith, M.R.C.S., L.R.C.P. (Lond.), High Street, Watford, were proposed for membership.

* This visit to the Zoological Gardeus was the last occasion on which the Society had the advantage of the presence, as Director, of one of its most valued members. Twice President, and frequently favouring the Society with one of his inimitable lectures, which always drew a large audience, Mr. Stradling was ever ready, when his health permitted, to preside at the evening meetings or to conduct the members over the Zoological Gardens or the Natural History or other London Museum. He was subject to frequent attacks of fever, contracted when studying nature in tropical and malarious countries, and shortly after this meeting, to the great regret of his many friends and admirers, his health completely broke down.

The following lecture was delivered:—

"Birds and their Nests in Hertfordshire." By Alan F. Crossman, F.L.S., M.B.O.U. An extempore lecture in place of which Mr. Crossman contributed for publication "A List of the Birds of Hertfordshire." (*Transactions*, Vol. X, pp. 84–102.)

The Lecturer said that with the aid of lantern-slides he would give some account of birds and their nests which he had observed in Hertfordshire. He thought that if the size of the county and its inland position were considered, the record of birds which had at various times been observed in it was a good one. So far as its birds were concerned Hertfordshire might be divided into three districts. In the part of the county towards London, which was chiefly grass land, would be found most of our warblers and birds of their kind. In the wooded portions such birds were also found, but there were more of the larger kinds. In the vast open fields in the north there were very few birds, considering the extent of that area. In former times there must have been many more. He might also mention that the reservoirs of Tring and Elstree were a great attraction to water-birds.

He then made a running commentary on the slides of the birds and their nests as they were shown on the screen, some from photographs, others from drawings.

Mr. T. Vaughan Roberts remarked on the occurrence of the kingfisher, which he thought was more common than Mr. Crossman imagined it to be, for he fished a good deal from time to time and rarely without seeing a kingfisher, especially in this neighbourhood.

Mr. Henry Lewis said that some little siskins were this year seen at West End, Essendon. They were interesting birds to study and to keep as pets, being tamer than any other birds he had ever kept. They would perch upon his finger. Their note was peculiar, being something like that of a penny trumpet.

The President remarked that many years passed without his seeing a kingfisher, the first he then saw being in the town of Hitchin. He had seen several this summer on the north coast of Cornwall. He was not aware before that the bird frequented salt water as well as fresh. There were also other birds there which he was not in the habit of seeing on the coast, and he suggested that it might be owing to the drought this year, the birds thinking that salt water was better than none at all. He thought that the kingfisher ought to be taken care of on account of its great beauty; if it did eat a few fish, they were fish which *we* do not eat as a rule.

Mr. Crossman replied that he did not intend to say that the kingfisher was really rare, but inclined to become so, and no doubt it would if netted under bridges, for it was a bird which flies very straight, and it would get into a net before it would notice it, especially the fine silk nets which were sometimes used The bird visited the coast after the nesting-season. He could not say what was the exact number of birds recorded in the county.

Mr. Hopkinson said that the number observed before Mr. Crossman commenced to record was about 205, but he thought the most satisfactory answer would be that Mr. Crossman intended to give a complete list of Hertfordshire birds in the 'Transactions.'

209th Ordinary Meeting, 17th January, 1899, at Watford.

William Whitaker, B.A., F.R.S., Pres.G.S., Assoc.Inst.C.E., President, in the Chair.

Mr. R. M. C. James and Mr. G. F. Smith were elected Members of the Society.

Mr. W. W. Claridge, Talbot Road, Rickmansworth, and Mr. Ernest Albert Sandeman, Presdales, Ware, were proposed for membership.

Illustrations of interesting geological features of the British Isles were shown by means of the Society's oxy-hydrogen lantern, being selections from a collection of lantern-slides formed by the British Association Geological Photographs Committee. Explanatory remarks upon them were made by the President and Mr. Hopkinson.

Two albums of geological photographs collected by the same Committee were also exhibited.

The following papers were read:—

1. "Report on the Conference of Delegates to the British Association at Bristol in 1898." By John Hopkinson, F.L.S., F.G.S., Assoc.Inst.C.E., Hon. Sec.

Having represented the Society at the Bristol meeting of the British Association, I have to present a report on the proceedings at the Conference of Delegates held there on the 8th and 13th of September. There are four members of our Society on the Corresponding Societies' Committee of the British Association, three of whom—Mr. W. Whitaker, F.R.S., Chairman, Mr. G. J. Symons, F.R.S., and your Delegate—attended both meetings.

First Meeting.

The Report of the Corresponding Societies' Committee was taken as read. It referred with satisfaction to the steady increase in the number of Corresponding Societies and the consequent increasing approximation to completeness in the index of their more important papers as a record of local work.

Coast-Erosion.—The subject selected for discussion at this Conference was that of Coast-erosion. It was brought forward by the Chairman, who, as President of our Society, will make some remarks upon it this evening. The chief result of the discussion was the passing of the following resolution:—

"That the Council of the British Association be requested to bring under the notice of the Admiralty the importance of securing systematic observations upon the erosion of the sea-coasts of the United Kingdom, and that the co-operation of the Coastguard might be profitably secured for this purpose."

Geological Photographs.—A letter was read from Professor Watts stating that the Geological Photographs Committee of the British Association had formed a collection of about 250 photographs and 100 lantern-slides, which could be sent to any local scientific society desiring to make use of them.

SECOND MEETING.

The Chairman stated that the Committees of the Geological and Geographical Sections had supported the resolution as to coast-erosion passed at the first meeting of the Conference.

Dr. Garson then took the chair, Mr. Whitaker having to leave.

Uniformity in Publications.—Professor S. P. Thompson brought forward the question of the importance of adopting one of two standard sizes for the pages of scientific publications, chiefly with the view of being able to bind together reprinted papers. A Committee of the British Association has been appointed for this purpose, and recommends the following as standard sizes:—

Standard octavo size: Paper *demy*, $5\frac{5}{8}$ in. wide × $8\frac{3}{4}$ in. high; width from stitching to edge of printed matter, $4\frac{5}{8}$ in.; height of printed portion including headline, 7 in. Limit of octavo size: paper not to be more than $\frac{1}{4}$ in. smaller than the standard each way, and letterpress not to occupy $\frac{1}{4}$ in. more space either way.

Standard quarto size: Paper *demy*, $8\frac{3}{4}$ in. wide × $11\frac{1}{4}$ in. high; width from stitching to edge of printed matter, $7\frac{1}{4}$ in.; height of printed portion including headline, $8\frac{1}{2}$ in. Limit of quarto size: as in octavo size except that the letterpress may be 9 in. high.

The Committee recommends that illustrations on plates should not exceed $5\frac{1}{8}$ in. × $7\frac{3}{4}$ in. for octavos, and $8\frac{1}{4}$ in. × 10 in. for quartos, the width being measured from the back of the book; and that when plates are folded the fold should not be less than 5 in. from the stitching in octavos and $8\frac{1}{8}$ in. in quartos.

Also that each article should begin a page, and if possible the right-hand page, and that reprints should either be issued with uncut edges, or with not more than $\frac{1}{8}$ in. cut off each margin.

In the discussion which ensued, the adoption of these recommendations was unanimously approved. Your Delegate stated that the number of publications of local scientific societies which were irregular in size and form was very small, societies which, from want of funds, published reprints from local newspapers, being the chief offenders. He approved of each paper beginning on the top of the page, but thought that the loss of space when there were many short papers would be too great for each paper to begin on a right-hand page. The present discussion would probably be of most value in guiding new societies.

Ethnographical Survey.—This is the only other subject of interest to our Society which was brought before the Conference. Dr. Garson said that few local societies were co-operating in this investigation. Full directions for guidance in the various departments of the work might be obtained from the papers issued by the Ethnographical Survey Committee. The important point was

to get a common standard of size, a very convenient one being one-seventh of the natural size. The amateur photographer would find a wide field of action in representing physical characteristics. Another subject was that of the ancient monuments and general archæology of a district. Other branches of the investigation were the collection of folklore and the noting of local names and dialects.

Mr. Hartland, the Secretary of the Ethnographical Survey Committee, said that it would greatly help his Committee if each of the Corresponding Societies would take up one or more branches of the inquiry, for it was not necessary that all branches should be taken up everywhere. He would be happy to send to any Corresponding Society all the information required as to the nature of the work and the way in which the Committee wished it to be carried on.

It is the desire of this Committee to record for various places in the United Kingdom, especially out-of-the-way villages, of which we have several in Hertfordshire, the following ethnographical features:—

(1) Physical types of the inhabitants.
(2) Current traditions and beliefs.
(3) Peculiarities of dialect.
(4) Monuments and other remains of ancient culture.
(5) Historical evidence as to continuity of race.

For the first and third branches of this inquiry certain books are required, and for the first also an instrument for physical measurements. The second relates to the collection of folklore, which may easily be undertaken by anyone. Every item of folklore should be collected—customs, games, traditions, sayings of the people, and superstitions connected with special days, marriages, births, deaths, cultivation of the land, or other events. If a custom or tradition relates to a particular place or object, such as a curious natural feature of the district, or an ancient monument or camp, some information should be given about such place or object. Any superstitions which are believed at one place and disbelieved at another, or the opposite believed, should be most carefully noted. The name, occupation, and approximate age of the person from whom the information is obtained should in all cases be carefully recorded.

The fourth branch of the inquiry is one which is peculiarly suitable for investigation by our Society, for we have in Hertfordshire many "monuments and other remains of ancient culture." It is required to plot on a map, describe, furnish photographs or sketches, and state the measurements and names (if any) of these according to the following classification:—

Drift implements. Caves and their contents.
Stone circles. Monoliths. Lake dwellings.
Camps. Enclosures. Collections of hut circles.
Cromlechs. Cairns. Sepulchral chambers.
Barrows, describing the form and stating which have been opened.

Inscribed stones. Figured stones. Stone crosses.
Castra (walled). Earthen camps.
Foundations of Roman buildings.
Cemeteries (with modes of sepulchre).
Burials, inhumation or cremation. Detailed contents of graves.
Types of fibulæ and other ornaments.
Coins. Implements and weapons, bronze, stone, or iron.
Other antiquities.
A list of place-names within the area, not modern.

Special note should be made of British, Roman, and Saxon interments occurring in the same field, and other signs of successive occupation.

The fifth branch—"historical evidence as to continuity of race"—may also be easily undertaken. The information required and the questions to be answered are as follows:—

Any historical events connected with the place, especially such as relate to early settlements in it or more recent incursions of alien immigration.

The nature of the pursuits and occupations of the inhabitants.

If any precautions have been taken by the people to keep themselves to themselves; if the old village tenures of land have been preserved.

Has any particular form of religious belief been maintained?

Are the people constitutionally averse to change?

What are the dates of the churches and monastic or other ancient buildings or existing remains of former buildings?

Do existing buildings stand on the sites of older ones?

How far back can particular families or family names be traced?

Can any evidence of this be obtained from the manor rolls; from the parish registers; from the tythingmen's returns; from guild or corporation records?

Are particular family names common?

In what county history or local history is the best description of the place to be found?

Evidences of historical continuity of customs, dress, dwellings, implements, etc., should be noted.

In conclusion, I may state that I shall be pleased to receive any communication on any of the questions here brought forward and to furnish copies of such communications to the Secretary of the Ethnographical Survey, keeping the original for presentation to our Society so soon as a sufficient amount of information has been received. It would be well for the rule of this Survey that communications must be written on foolscap paper, on one side only, with a margin of an inch on the left-hand side, to be adhered to.

2. "On some Changes along our Coasts." By the President.

Mr. Whitaker said that all persons were interested in the scenery of our shores, whether living in counties bordering the

sea or wholly inland as in Hertfordshire. Moreover, some counties having a coastline had few or no local scientific societies, and might need help from an inland society such as ours. It was now possible to obtain maps on the scale of 6 inches to the mile for all localities, and on these measurements could be made from the edge of the cliffs, at any given time, to the nearest roads, footpaths, hedges, cottages, or other objects, and the amount of land lost since the map was made could be accurately ascertained. Of course all such measurements should be dated.

In illustration of the loss which has been sustained in certain places he might mention Sheppey. The Geologists' Association had made three excursions there. On their first visit the church and churchyard of Warden were untouched. Some years later the churchyard was found to have been partly destroyed, and coffins were seen sticking out from the edge of the cliff. Last year neither church nor churchyard could be seen. There was another form of encroachment by the sea which had been well displayed during a recent visit of the Geologists' Association to Aldeburgh in Suffolk. There they found many cottages, sheds, and gardens more or less injured or even destroyed by the heaping up of masses of shingle in or against them, the result of a storm in November, 1897, which had caused much damage over many miles of our coast. Much injury to land adjoining the sea was also often done by blown sand, which here and there had been driven to considerable heights, covering areas of some breadth, as he had recently seen on the northern coast of Cornwall.

The help of the photographer was extremely valuable in giving an unassailable record of a past state of things; the damage done by natural forces being often greatly obscured in a comparatively short period of time. The photo-theodolite might frequently be useful in this matter.

Turning to the economical aspect of the question, Mr. Whitaker remarked that there were two things especially worthy of attention—(1) the removal of shingle from the shore, (2) the quarrying of stone on the faces of sea-cliffs. There were certainly some places where the removal of shingle from the shore should never be allowed; nowhere should it be permitted without some thought as to the probable result. And the quarrying of stone on the face of a sea-cliff often had a powerful influence in aiding the erosive agencies of Nature.

Archæologists would be interested in noting spots where old British camps had been partly destroyed by the sea; examples of which he had noticed on the Chalk of Dorset and on the much harder rocks which form the cliffs of northern Cornwall.

Observations of this kind were not only calculated to make us realize the differences between the outlines of the coast now and in pre-historic times, but they also led us to try to imagine the probable changes in the future.

Lantern-views of coast-scenery were exhibited in illustration of the paper.

Mr. Alfred E. Cox and Mr. J. Kirkby Riggall were elected Auditors of the accounts for the year 1898.

210TH ORDINARY MEETING, 28TH FEBRUARY, 1899, AT WATFORD.

WILLIAM WHITAKER, B.A., F.R.S., Pres.G.S., Assoc. Inst.C.E., President, in the Chair.

Mr. W. W. Claridge and Mr. Ernest Albert Sandeman were elected Members of the Society.

Mr. Isaac Butler, Laurel Bank, King's Langley; Mr. Walter Grover, East Lodge, Hemel Hempstead; and Mr. Edward Percy Thompson, Elstree, were proposed for membership.

24TH ANNIVERSARY MEETING, 28TH FEBRUARY, 1899.
(AT WATFORD.)

WILLIAM WHITAKER, B.A., F.R.S., Pres.G.S., Assoc. Inst.C.E., President, in the Chair.

The Report of the Council for the year 1898, and the Treasurer's Account of Income and Expenditure, were read and adopted.

The President delivered an Address on "Geological and Other Work in Hertfordshire." (*Transactions*, Vol. X, pp. 105–118.)

The following gentlemen were duly elected as the Officers and Council for the ensuing year:—

President.—The Right Honourable the Earl of Verulam.

Vice-Presidents.—John Attfield, M.A., Ph.D., F.R.S., F.C.S., F.I.C.; Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., F.R.S., V.P.S.A., etc.; George Rooper, F.Z.S.; William Whitaker, B.A., F.R.S., Pres.G.S., etc.

Treasurer.—John Weall.

Honorary Secretaries.—John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.R.Met.Soc., Assoc. Inst. C.E.; W. R. Carter, B.A.

Librarian.—Daniel Hill.

Curator.—A. E. Gibbs, F.L.S., F.R.H.S.

Other Members.—Charles Ashdown, F.C.S., F.R.G.S.; Edward M. Chater; Alfred E. Cox, M.R.C.S., L.R.C.P.; W. Gruggen, L.R.C.P.E.; Thomas East Lones, M.A., LL.B., B.Sc.; F. C. Mahon; John Morison, M.D., D.P.H., F.G.S.; George P. Neele; William Page, F.S.A.; James Saunders; F. W. Silvester; W. Lepard Smith.

The thanks of the Society were accorded to Mr. William Whitaker, B.A., F.R.S., retiring from the office of President; to Mr. Vaughan Roberts and Mr. Arthur Stradling, retiring from the office of Vice-President; and to Mr. Arthur P. Blathwayt, Mr. F. M. Campbell, F.L.S., Mr. Alan F. Crossman, F.L.S., and Mr. Herbert George Fordham, retiring from the Council.

Report of the Council for the Year 1898.

The Council of the Hertfordshire Natural History Society, in presenting the 24th Annual Report, regrets to announce that there continues to be a falling-off in the number of Members. Although this is in great measure due to the resignation of members who have removed from the County, there is evidence, in the small attendance at most of the Watford meetings, of a waning interest in the proceedings of the Society in its original home. The Field Meetings, on the other hand, only three of which were held during the year, have been well attended.

During the year six ordinary members have been elected; eighteen members have resigned; one member has been removed from the list for non-payment of subscription for several years; and the Council regrets to have to record the loss by death of one Honorary Member—Professor Allman, F.R.S.—and one Ordinary Member—Mr. Abel Smith, M.P.

George James Allman died on the 24th of November at the ripe age of 86, having been born at Cork in 1812. Fortunately for science he was able to follow his natural inclinations, first abandoning the Bar, for which he was educated, and then the medical profession, for which he qualified, becoming Regius Professor of Botany in Dublin University in the year in which he took his M.D. degree, and Regius Professor of Natural History in the University of Edinburgh ten years later. Although his writings are versatile and prolific, contributing to our knowledge of nearly every group of animals from the Protozoa to the Mammalia, his work is thorough, and for over seventy years he had microscope and dissecting-knife in almost constant use. His 'Monograph of the Gymnoblastic or Tubularian Hydroids' is his greatest work, and of all the splendid Natural History monographs of the Ray Society this is the finest. Its exquisite coloured plates are faithful copies of his original drawings. He worked at fossil as well as recent Hydrozoa, and it was through the concurrent study of the graptolites that your Editor became acquainted with him. He was President of the British Association in 1879 and of the Linnean Society from 1874 to 1881, and was one of our original Honorary Members, having been elected in February, 1875.

By the death, on the 30th of May, of Mr. Abel Smith, Hertfordshire has lost a generous benefactor and a staunch Parliamentary representative, whose political connection with the County extended over the long period of forty-four years.

The census of the Society at the end of the years 1897 and 1898 was as follows:—

	1897.	1898.
Honorary Members	17	16
Corresponding Members	3	3
Life Members	46	46
Annual Subscribers	149	137
	215	202

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The following papers or lectures have been read or delivered at Watford during the year :—

Jan. 25.—Nature on and around Mount Sinai ; by D. Harvey Attfield, M.A., M.B., D.P.H.

Feb. 22.—Anniversary Address—Chalk Water in Hertfordshire ; by the President, William Whitaker, B.A., F.R.S., Pres.G.S., Assoc. Inst. C.E.

March 22.—Report on the Conferences of Delegates to the British Association at Toronto in 1897 ; by John Hopkinson, F.L.S., F.G.S., Assoc. Inst. C.E.

—— Report on the Rainfall in Hertfordshire in the Year 1897 ; by John Hopkinson.

—— The Palæolithic Deposits at Hitchin and their Relation to the Glacial Epoch ; by Clement Reid, F.L.S., F.G.S.

April 26.—Meteorological Observations taken in Hertfordshire in the Year 1897 ; by John Hopkinson, F.L.S., F.G.S., etc.

—— Report on Phenological Phenomena observed in Hertfordshire during the Year 1897 ; by Edward Mawley, Sec.R.Met.Soc.

—— Notes on Birds observed in Hertfordshire during the Year 1897 ; by Alan F. Crossman, F.L.S.

—— Miscellaneous Notes and Observations—Meteorology ; Botany ; Zoology.

Nov. 15.—The Chadwell Spring and the Hertfordshire Bourne ; by John Hopkinson, F.L.S., F.G.S., etc.

Dec. 13.—Birds and their Nests in Hertfordshire ; by Alan F. Crossman, F.L.S.

The following lecture was delivered at St. Albans :—

March 18.—A Visit to Canada and the Falls of Niagara ; by John Hopkinson, F.L.S., F.G.S., etc.

The following Field Meetings were held during the year :—

May 7.—Ashridge Park and Gardens.
—— 14.—Ayot Green and Hatfield Hyde.
June 11.—Latimer and Chenies.

The Society is indebted to Earl Brownlow for permission to visit the Gardens of Ashridge House, and to the Duke of Bedford for permission to inspect the Russell Chapel in Chenies Church.

The meeting on the 14th of May was held in conjunction with the Geologists' Association, and that on the 11th of June in conjunction with the St. Albans Archæological Society.

On the 30th of April a visit was paid to the Natural History Museum, South Kensington, when Dr. Henry Woodward, F.R.S., Keeper of Geology, showed and explained some additions recently made to the geological and zoological collections, including the new Whale Room before it was opened to the public ; and on the 25th of June the Zoological Gardens, Regent's Park, were visited under the guidance of Mr. Arthur Stradling, who directed special attention to such creatures as are on the verge of extinction.

Three parts of the ninth volume of the present series of the Society's 'Transactions,' and one part of the tenth volume, containing 126 pages, have been published during the year. Twenty-four out of the twenty-eight papers in the ninth volume record the results of local investigation. There are ten papers which treat of the Meteorology and Phenology of Hertfordshire, being

the usual eight annual reports (on the rainfall, climatology, and phenology of the County, and on the meteorology of St. Albans, each for two years), a paper on Hertfordshire rainfall, percolation, and evaporation, and one on the climate of St. Albans; to the Botany of the County there are five contributions, two adding to our knowledge of the Characeæ and the mosses, two giving earlier County records of flowering plants than were known to Pryor when writing his 'Flora of Hertfordshire,' and one giving an account of the destruction of a tree by fungi; in Entomology there are two annual reports on the Lepidoptera; in Ornithology the usual annual reports and a paper on the birds of North Hertfordshire; and in Archæology papers on coins found at Watford, and at Brickendonbury, Hertford. An account of the earthquake of December, 1896, and a record of the water-levels in the Chalk near Royston, complete the local papers. Those which do not relate to Hertfordshire are on mutual aid amongst animals, on parasitic fungi, on the observation of swallows, and on the Röntgen rays. In the 'Proceedings' are reports on the Conferences of Delegates to the British Association at Ipswich in 1895 and at Liverpool in 1896, in which are pointed out local work which may be done by members of the Society, and an abstract of a lecture on forest, field, and flood. The volume is illustrated by six plates and twelve illustrations in the text.

The funds of the Society are in a satisfactory condition, the adverse balance with which the account for the previous year closed having been converted into a small balance in favour of the Society. This is due partly to decreased expenditure, that for the year 1897 having been heavier than usual owing to the purchase of an oxy-hydrogen lantern, and partly to the subscriptions of members having been paid more promptly than in the previous year, there being now fewer arrears.

The donations to the Library, chiefly of publications of Societies and of the splendid series of volumes presented by the United States Government scientific departments, have been so numerous that there is a difficulty in finding room for them.

In view of the small attendance at the evening meetings at Watford, the Council may find it advisable to take into consideration as to whether or not some changes in procedure should be made. The Field Meetings have completely changed in character, from rambles in the neighbourhood of Watford, short-distance and then longer-distance railway journeys to places of interest, to cycling excursions, which were so much appreciated last year that some of the members who took part in them have already expressed a desire for similar excursions to be arranged this year. That the work of the Society is also appreciated by members who reside at too great a distance from Watford to enable them to attend the evening meetings, is evidenced by your Editor having lately received several expressions of the pleasure with which the 'Transactions' are received and read.

INCOME AND EXPENDITURE FOR THE YEAR 1898.

Dr.	£	*s.*	*d.*	Cr.	£	*s.*	*d.*
To Entrance Fees	5	0	0	By Balance due to Treasurer	7	9	10
,, Subscription for 1894	0	10	0	,, Printing 'Transactions'	31	13	0
,, Subscriptions for 1895	2	0	0	,, Miscellaneous Printing	4	19	0
,, ,, ,, 1896	3	10	0	,, Expenses of Meetings	5	3	3
,, ,, ,, 1897	10	0	0	,, Library expenses	7	12	9
,, ,, ,, 1898	47	10	0	,, Salary of Assistant	5	0	0
,, ,, ,, 1899	10	10	0	,, Postages	10	16	7
,, Dividends on £130 India 3 per cent. Stock	3	18	0	,, Stationery and Sundries	0	14	3
,, Sale of Publications ('Flora of Hertfordshire' 7*s.*; 'Transactions' 13*s.* 2*d.*, less expenses)	1	0	2	,, Fire Insurance	0	12	6
				,, Balance at Bank	9	17	0
	£83	18	2		£83	18	2

Amount invested in the purchase of £130 India 3 per cent. Stock . . . . £126 15*s.* 6*d.*

Audited and found correct this 25th day of February, 1899, { ALFRED E. COX, J. KIRKBY RIGGALL.

Additions to the Library in 1898.

Presented.

Title.	Donor.
Abercrombie, Hon. Ralph. Australian Weather. 8vo. Sydney, 1896	*Sir John Evans.*
British Association for the Advancement of Science. Report for 1897. (Toronto.) 8vo. London, 1898	*The Association.*
British Astronomical Association. Journal. [Various numbers, not catalogued.]	*Miss E. Wigram.*
———. Memoirs. [Ditto.]	,,
Pleydell, E. M. Flora of Dorsetshire. 8vo. London, 1874	*Sir John Evans.*
Symons, G. J. (Ed.). Monthly Meteorological Magazine. 8vo. London, 1898	*The Editor.*
Warington, R. A Contribution to the Study of Well-Waters. 8vo. London, 1887	*Mr. W. Whitaker.*
Whitaker, W. Some Middlesex Well-Sections. (*Trans. Brit. Assoc. Waterworks Eng.*, 1897.)	*The Author.*

Received in Exchange.

American Museum of Natural History. Report for the Year 1897. 8vo. New York, 1898.

———. Bulletin. Vol. ix. 1897. Vol. x. 1898. 8vo. New York.

Barrow Naturalists' Field Club. Annual Report and Proceedings. Vol. xii. 8vo. Barrow, 1898.

Bath Natural History and Antiquarian Field Club. Proceedings. Vol. ix, part 1. 8vo. Bath, 1898.

Boston Society of Natural History. Proceedings. Vol. xxviii. 8vo. Boston (U.S.A.), 1898.

Bristol Naturalists' Society. Proceedings. New Series. Vol. viii, part 2. 8vo. Bristol, 1897.

Cardiff Naturalists' Society. Report and Transactions. Vol. xxix. 8vo. Cardiff, 1898.

Croydon Microscopical and Natural History Club. Transactions. 1893–98. 8vo. Croydon, 1893–98.

Edinburgh Geological Society. Transactions. Vol. viii, part 3. 8vo. Edinburgh, 1897.

Glasgow Natural History Society. Proceedings. New Series. Vol. v, part 1. 8vo. Glasgow, 1898.

———, Philosophical Society of. Proceedings. Vol. xxix. 8vo. Glasgow, 1898.

London, Geological Society of. Abstracts of the Proceedings. Session 1897–98. 8vo. London, 1898.

———. Geologists' Association. Proceedings. Vol. xv, parts 6–10. 8vo. London, 1898.

———. Quekett Microscopical Club. Journal. Vol. vi, Nos. 42, 43. 8vo. London, 1898.

———. Royal Meteorological Society. Quarterly Journal. Vol. xxiv. 8vo. London, 1898.

———. ———. Meteorological Record. Vol. xvii, Nos. 67, 68; vol. xviii, Nos. 69–71. *Ib.*

———. Royal Microscopical Society. Journal. 1898. 8vo. London, 1898.

Manchester Field Naturalists' Society. Report and Proceedings for the Year 1897. 8vo. Manchester, 1898.

——— Geographical Society. Journal. Vol. xiv, parts 1–6. 8vo. Manchester, 1898.

Manchester Geological Society. Transactions. Vol. xxv, parts 12–21. 8vo. Manchester, 1898.
——— Literary and Philosophical Society. Memoirs and Proceedings. Vol. xlii, parts 1–6. 8vo. Manchester, 1898.
——— Microscopical Society. Report, 1897. 8vo. Manchester, 1898.
Missouri Botanical Gardens. 8th Annual Report, for 1896. 8vo. St. Louis, 1897.
New York Academy of Sciences. Annals. Vol. x; vol. xi, part 1. 8vo. New York, 1898.
———. Transactions. Vol. xvi. *Ib.*
Norfolk and Norwich Naturalists' Society. Transactions. Vol. vi, part 4. 8vo. Norwich, 1898.
Northamptonshire Natural History Society and Field Club. Journal. Vol. x, Nos. 69–72. 8vo. Northampton, 1898.
Philadelphia Academy of Natural Sciences. Proceedings. 1897, parts 1–3; 1898, parts 1, 2. 8vo. Philadelphia, 1897–98.
Rio Janeiro, Museu Nacional do. Revista. Vol. i. 4to. Rio de Janeiro, 1896.
Rugby School Natural History Society. Report for the year 1897. 8vo. Rugby, 1898.
Somersetshire Archæological and Natural History Society. Proceedings. Vol. xliv. 8vo. Taunton, 1898.
United States Department of Agriculture. Year Book for 1897. 8vo. Washington, 1898.
——— Geological Survey. Monographs. Vol. xxx.—Fossil Medusæ. 8vo. Washington, 1898.
——— ———. Bulletin. Nos. 88, 89, 149. *Ib.*
Upsala University Geological Institution. Bulletin. Vol. iii, part 2, No. 6. 8vo. Upsala, 1898.
Warwickshire Naturalists' and Archæologists' Field Club. Proceedings, 1897. 8vo. Warwick, 1898.
Washington. Smithsonian Institution. Report of the United States National Museum for 1895. 8vo. Washington, 1897.
Wiltshire Archæological and Natural History Society. Magazine. Vol. xxx, Nos. 89, 90. 8vo. Devizes, 1898.
———. Abstracts of Wiltshire Inquisitiones Post Mortem. Part 6. *Ib.*
———. Catalogue of Drawings and Prints in the Library. *Ib.*, 1897.
Yorkshire Geological and Polytechnic Society. Proceedings. Vol. xiii, part 3. 8vo. Leeds, 1898.
——— Naturalists' Union. Transactions. Yorkshire Carboniferous Flora. Part 21. 8vo. Leeds, 1898.
——— ———. Naturalist. N.S. Vol. xxiii. 8vo. Leeds, 1898.

Purchased.

Botany, Journal of. Vol. xxxvi. 8vo. London, 1898.
Boulenger, G. A. Tailless Batrachians of Europe. Part 2. (*Ray Society.*) 8vo. London, 1898.
Entomologist. Vol. xxxii. 8vo. London, 1898.
Middlesex and Hertfordshire Notes and Queries. Vol. iv. 8vo. London, 1898.
Nature Notes. Vol. ix. (*Selborne Society.*) 8vo. London, 1898.
Novitates Zoologicæ. Vol. v. 8vo. Tring, 1898.
Year-book of the Scientific and Learned Societies of Great Britain and Ireland . . . 1897. 8vo. London, 1898.
Zoologist. 4th Series. Vol. ii. 8vo. London, 1898.

211TH ORDINARY MEETING, 23RD MARCH, 1899, AT ST. ALBANS.

The RIGHT HONOURABLE THE EARL OF VERULAM, President, in the Chair.

Mr. G. W. Blow, 12, St. Peter's Street, St. Albans, and Mr. Edwin Skett, Seftonville, Harpenden, were proposed for membership of the Society.

The following lecture was delivered :—

"Colour in Nature." By Wilfred Mark Webb, F.L.S.

The lecture was illustrated by lantern-slides and experiments on complementary colours, etc., made with the aid of two lanterns.

212TH ORDINARY MEETING, 28TH MARCH, 1899, AT WATFORD.

WILLIAM LEPARD SMITH, Esq., in the Chair.

Mr. G. W. Blow, Mr. Isaac Butler, Mr. Walter Grover, Mr. Edwin Skett, and Mr. E. P. Thompson were elected Members of the Society.

The following papers were read :—

1. "On some Effects of the Hailstorm of the 24th of June, 1897, in Hertfordshire and Bedfordshire." By James Saunders. (*Transactions*, Vol. X, pp. 119–120.)

2. "Note on Lunar Halos observed in Hertfordshire." Communicated by John Hopkinson, F. R. Met. Soc. (*Transactions*, Vol. X, p. 118.)

3. "Report on Phenological Phenomena observed in Hertfordshire during the Year 1898." By Edward Mawley, Sec. R. Met. Soc., F.R.H.S. (*Transactions*, Vol. X, pp. 129–135.)

4. "Report on the Mycetozoa of the South Midlands for the Years 1895 to 1898." By James Saunders. (*Transactions*, Vol. X, pp. 103–104.)

5. "Notes on Birds observed in Hertfordshire during the Year 1898. By Alan F. Crossman, F.L.S., M.B.O.U. (*Transactions*, Vol. X, pp. 136–142.)

6. "Note on Wagtails feeding a young Cuckoo." By Mrs. Russell Carew. (*Transactions*, Vol. X, p. 102.)

7. "Notes on Curious Nesting-places." Communicated by John Hopkinson. (*Transactions*, Vol. X, p. 102.)

The following papers were taken as read :—

1. "Report on the Rainfall in Hertfordshire in the Year 1898." By John Hopkinson, F.L.S., F.G.S., F. R. Met. Soc., Assoc. Inst. C. E. (*Transactions*, Vol. X, pp. 121–128.)

2. "Meteorological Observations taken in Hertfordshire in the Year 1898." By John Hopkinson, F.L.S., etc. (*Transactions*, Vol. X, pp. 143–152.)

Field Meeting, 13th May, 1899.

KNEBWORTH PARK.

The chief object of the first field meeting in the year was to give the members of the Society the opportunity of seeing the gardens of Knebworth House, permission having been kindly granted by Lord Strathcona and Mount Royal. The meeting was under the direction of Mr. Hopkinson, who conducted a party of cyclists from St. Albans, by Sandridge and Wheathampstead, through Lamer Park, past the picturesque ruined church of Ayot St. Lawrence, and by way of Ayot Park and Codicote Bottom across the pretty valley of the Mimram, leaving the village of Codicote on the right.

The place of meeting was Knebworth Church, where the cyclists found several members who had come by train awaiting them and were soon joined by others who had driven from St. Albans. The church stands in the park a short distance to the east of the house, and is surrounded by trees, the fresh vernal foliage of which formed a pleasing contrast with the dark grey walls of the building. It consists only of chancel, nave, and tower at the western end surmounted by a good specimen of the short steeple characteristic of the county and known as the "Hertfordshire spire." It has one or two Norman arches, but the prevailing style of architecture is Early English. There are several brasses, the finest one, on the floor in the middle of the chancel, representing a priest, and bearing the date "MCCCCXIIII." But the principal attraction of the interior is the Lytton Chapel, which is situated on the north side of the chancel, and contains several marble monuments and other memorials of the distinguished literary family whose name is indissolubly associated with the locality.

On leaving the church, the members entered the private grounds of Knebworth House, and, in the absence of Lord Strathcona, were received by his son-in-law, Mr. Howard, and shown over the gardens by him and the head-gardener, Mr. John Kipling, who is an old servant of the Lyttons and pointed out the favourite nooks of the great novelist and some of the improvements made by him. The Italian garden, with its fountains, statues, and extensive parterres; the maze; the shady fernery with its winding walks; and the wilderness, were successively visited.

The Italian Garden is four acres in extent, and in it are some of the finest conifers in the grounds, the most notable being a *Wellingtonia gigantea* 45 feet high,* a very healthy and evergreen Japanese cedar (*Cryptomeria japonica*) 35 feet high, a *Cedrus deodara* 45 feet high with branches 52 feet in length, and a handsome monkey-puzzle tree (*Araucaria imbricata*). In other parts of the gardens are fine specimens of *Cupressus Lawsoniana* 35 feet high, *Thuja gigantea* 30 feet high, *Abies Smithiana* 25 feet high, and the Himalayan weeping-pine (*Pinus excelsa*). The most interesting portion of the grounds to naturalists is the wilderness,

* The measurements are by Mr. Kipling.

seven acres in area, the creation of the late Earl of Lytton. The following account of it, and of the park and woods, is contributed by Mr. Kipling :—

"In the Wilderness have been brought together flowering trees and shrubs in vast numbers, various kinds of native wild plants, and many old-fashioned garden flowers—flowers which appealed to the late Earl's poetic fancy, having been loved and cherished by him in his boyhood. Of these may be mentioned wall-flowers, pinks, cabbage-roses, sweet-briar, and rosemary, and of the wildings, fox-gloves, toad-flax, primroses, columbines, corn- and marsh-marigolds, and many native orchids. But its leading feature is the unique collection of thorns, there being some thirty-seven species and varieties, which when in blossom make a grand floral display. It is now rapidly filling up with thousands of trees, shrubs, and more lowly plants, and each succeeding year finds it the haunt of ever-increasing numbers of the feathered tribe, both resident and migratory, as well as of insects innumerable.

"This Wilderness was the favourite garden of the late Earl. Here he came from his hard literary labours for his morning or afternoon walk, to watch the progress which his favourite plants were making, and to enjoy them in the only way that the true lover of flowers can do so, that is, to see them on the plants on which they grow, not caring to have them cut and placed in the house in vases, where they would to him be shorn of their greatest interest and beauty. It was a daily pleasure to him when in residence at Knebworth to watch the development of this his semi-wild garden. Here I have spent hours with him planning and planting, as I had spent hours with his father before him in other parts of the grounds, at such times going about together more as friend and companion than as master and servant, the longest day's toil then being a pleasure.

"Knebworth Park is noted for its old avenues of lime and horse-chestnut trees, its groves of oak, beech, elm, and hornbeam, and two or three venerable individuals of Spanish chestnut, the largest of these being 26 feet in circumference at 2 feet from the ground. The mistletoe is found growing plentifully on many of the trees, including the lime, poplar, crab, thorn, sycamore, and mountain-ash, but none grows on the oak.

"Knebworth Woods are extensive and not without interest to the botanist, entomologist, and archæologist. Of native plants which delight in the shady haunts of the woodland may be mentioned the purple helleborine (*Epipactis latifolia*), the bird's-nest orchis (*Neottia nidus-avis*), and the large-flowered butterfly orchis (*Platanthera chlorantha*). Ferns are plentiful, including *Blechnum spicant*, *Athyrium filix-fœmina*, and *Lastrea spinulosa* and *dilatata*.

"In Humley's and Grafridge Woods are two Roman tumuli, and the outlines, which can yet be traced, of a Roman encampment. When a long low-lying meadow beside the latter wood was being drained I picked up a well-preserved specimen of a quern or Roman millstone which had been thrown out in the cutting of the drain. It was made of the Hertfordshire conglomerate, consisting of small rounded pebbles embedded in a siliceous matrix."

From the gardens the park was crossed to the lake, which is an artificial expansion of a small tributary of the Beane some distance from the house. The ornamental grounds around it are prettily laid out, and the situation in the valley with the woods in the background is one of much natural beauty.

Returning to the church the party separated, some leaving by train, and the cyclists, with a few who were driving, crossing the park to Codicote. Here nearly twenty had tea by previous arrangement, after which some returned to St. Albans, etc., by Welwyn, Lemsford, and Astwick Manor, and others by Wheathampstead and Sandridge.

Field Meeting, 27th May, 1899.

BUSHEY, WATFORD HEATH, AND HARROW WEALD.

The Geologists' Association has lately set apart a few excursions each year especially for cyclists, and this was one in which members of the Hertfordshire Society were invited to join. The geological direction was entrusted to the Rev. J. F. Blake, F.G.S., and the local arrangements were carried out by Mr. Hopkinson.

The Bushey chalk-pit, east of the railway, which is just beyond the edge of the London Tertiary basin, was first visited. It is in the Upper Chalk, and although this formation is immediately succeeded less than a furlong to the south by the Reading Beds, the highest zone of the Chalk which occurs in this country is not present. Although apparently conformable with the Chalk, the Reading Beds are not really so, overlapping different members of it, and thus showing that the Tertiaries were deposited upon the denuded surface of the Secondary rocks. Above the Chalk is some pebble-gravel, and above that there is brickearth in one part of the pit and yellow sand in another. Mr. Blake pointed out the purity of the sand and clay (brickearth), which he thought indicated that neither bed had been brought from a distance, both being the relics of Tertiary strata formerly extending farther northwards than they do at present.

A short distance to the east of this pit, on the road to Bushey, good exposures of similar gravel were seen in a new excavation, and Mr. Blake inferred from the different levels of this gravel that it was deposited after the main excavation of the valley.

The Old Bushey and the New Bushey brickfields were then visited, and in the latter the basement-bed of the London Clay with a band of pebbles was seen. Underneath it are the sandy clays of the Reading Beds with fragmentary traces of fossils, and below these are ferruginous sands and pebbles worked for about eight feet without getting to the bottom. In what a short distance the character of the Reading Beds changes was shown by the presence, on the south side of the pit only, of some curious bands of very light-coloured rock looking in the distance almost like chalk, which were found to be more compact and calcareous than usual.

Proceeding to Watford Heath, a collection of fossils made by the late Mr. W. T. Stone, who was a member of both the Hertfordshire Society and the Geologists' Association, was exhibited by his son. Many of them are local, but the collection is a very varied one. Mr. Stone's most interesting discovery was that of the bone of a monkey in the London Clay in his own brickfield. This was determined by Professor Owen, to whom it was sent, to belong to *Hyracotherium leporinum*. Here is exposed the pebbly basement-bed of the London Clay from which were obtained the numerous sharks' teeth and oyster-shells which had just been seen, and a few fossils were found in it. The underlying sands are much more largely developed here than at either of the Bushey pits, and they

are very pure and white. It was stated that they go down fourteen feet below the level of the present workings, the chalk occurring at such a depth that it is found more economical to cart it from Bushey than to obtain it on the spot.

The members then rode by Oxhey Lane to Harrow Weald, inspecting on the way the ancient earthwork known as Grimes' or Græm's Dyke. Tea had been ordered at "The Case is Altered," in the "City," so called because the site of a Roman station, and after partaking of it, and obtaining from the high ground a good view of the country towards London, including the Bagshot Sand outlier of Harrow Hill, the party dispersed, some riding to London and others to Watford and St. Albans.

Field Meeting, 10th June, 1899.

RICKMANSWORTH AND HAREFIELD.

Some of the finest and most instructive sections of the Upper Chalk in the neighbourhood of London are to be seen at Harefield, where, facing the Grand Junction Canal in the valley of the Colne, there are three large chalk-pits within a distance of a mile and a half, permission to visit which had been obtained. The meeting was under the direction of Mr. W. Whitaker, F.R.S., President of the Society, and Mr. John Hopkinson, Hon. Secretary, and was held in conjunction with the Geologists' Association. Most of the members of the County Society cycled from Watford, etc., a few drove, and the members of the Geologists' Association came by train from London.

Ascending a hill half a mile south of Rickmansworth, a very fine view of the valleys of the Colne, Chess, and Gade was obtained. The hill is capped by a thick bed of gravel, one advantage of which, Mr. Whitaker said, is that we may call it what we like and no one can contradict us, for it may be almost anything. He could only say that it was a pebbly gravel, as coloured on the Geological Survey map. He believed that it was not Post-glacial, and that it had nothing to do with the existing river in the valley below. In this valley watercress-beds might be seen, fed by springs from the Chalk, and sometimes by borings made to obtain an increased supply of water.

Less than another half-mile to the south is Woodcock Hill Kiln, and here the plastic mottled clays of the Reading Beds were seen surmounted by the basement-bed of the London Clay, consisting of sandy clay and loam with a layer of flint-pebbles in the middle. Below the mottled clay are fairly-white and brownish sands, and resting in hollows in the London Clay is a clayey gravel. The mottled clays were seen to hold up water which percolates through the sandy bed above it.

A pleasant walk of two miles across the fields brought the party to Harefield, where tea was partaken of. The Harefield Brick and Cement Works, just beyond the southern end of the village, were

then visited. There is here a very fine section of the Chalk, Reading Beds, and London Clay with its basement-bed, which has been described by Mr. Whitaker in his 'Geology of the London Basin' (vol. i, p. 196).

The section is now rather clearer than when that description was drawn up. The mottled clays of the Reading Series are fully exposed, and the grey sand and clay appear to have a considerable extent. The only foreign rock seen in the bed of flint-pebbles (at the bottom) was an iron-sandstone, rather friable. Mr. Whitaker remarked that this bed was much like the Hertfordshire puddingstone, except that it was not in Hertfordshire and was not a puddingstone. It was in Middlesex, but close to the Herts border, and although the pebbles were not consolidated with silica, there was silica present in the form of sand. Several fossils were obtained in the basement-bed of the London Clay. Shells chiefly occur in masses, but are not in a good state of preservation.

Passing the Asbestos Mills, formerly, as marked on the Ordnance map, the "Copper Mills," the Harefield Lime Works were visited. Here there is a section of the Upper Chalk nearly 100 feet in height, giving a better illustration of the phenomenon of "pipes" than is to be seen elsewhere within many miles of London. It was quite clear, Mr. Whitaker said, that the irregular masses of loose sand and gravel which extend downwards in them from the top of the pit had really been let down from above. No surface-action could have formed them; the Chalk had evidently been dissolved away by water percolating through fissures, and the sand and gravel had gradually taken its place. The Chalk was seen to be quite evenly bedded.

Crossing the fields to the Springwell Chalk Pit, it was noticed that the Chalk was very little fissured by pipes, this being due to a bed of comparatively impervious clay on the top. Although this pit has been worked for at least thirty years, it is not indicated on the 6-inch Ordnance map.

After a vote of thanks had been recorded to the Directors the party separated, the cyclists leaving those who came by rail to take a short walk along the towing-path of the canal to Rickmansworth Station.

Field Meeting, 24th June, 1899.

SHEPHALL, ASTON, AND FROGMORE HALL.

This was the only field meeting in the year for which hospitality was offered, and the choice for it of Midsummer Day proved most satisfactory. A threatening cloud passing away soon after 10 o'clock, the weather henceforth was perfect, and although the meeting was devoid of scientific results from a naturalist's point of view, it was of considerable archæological interest.

The meeting was under the direction of Mr. Hopkinson, who conducted a party of cyclists from St. Albans, whither a few had

come from Watford, to Frogmore Hall, the residence of Mr. G. B. Hudson, M.P. for North Herts, who had kindly invited the members to tea.

The route taken was through Sandridge, Wheathampstead, and Codicote, over the hill by Knebworth into the valley of the Beane, half a mile along the Great North Road to Broadwater, and thence through Shephalbury Park, by kind permission of Mrs. Heathcote, to Shephall. Here a halt was made, and, passing through the picturesque old (genuinely old) lych-gate, the Church of St. Mary was visited. The most interesting memorials in the church are two brasses, one to the memory "of [Georg]e Nodes Gentylman sarjeant of y^{e} Bockehoundes to King Henry the viijth Edward y^{e} vjth Quene Mary and to Quene Elizabeth. Which Dyed the xvijth day of May An^{o} 1564 and Margaret his wyff . . . ;" and the other to that of "Margaret Noodes y^{e} wyfe of Gorge Noodes late of Shephall berry Sargeaunt of y^{e} Bucke Houndes unto Kinge Edward Quene Mary & Quene Elizabeth, which Margaret deceassed the vith daye of January in the yeare of our Lord God 1582."

By a pretty country lane Aston was reached, and after partaking of a light luncheon the party visited the old Elizabethan manor-house of Astonbury, of which the chief features of interest are the two carved oak staircases, and the long room at the top of the house, extending its whole length. Here a few more joined the cyclists, some having driven from St. Albans, and others having walked from Knebworth Station.

After going over the house and viewing what remains of the moat by which it appears to have been at one time surrounded, the members left for Frogmore Hall, where they arrived at 4 o'clock. A welcome rest on a shady lawn was followed by a pleasant stroll through the gardens and glass houses, and then about four-and-twenty sat down in the dining-room to a substantial meat tea. The thanks of the Society, and especially of the members and their friends present, were then, on the proposition of the Director, accorded to Mr. Hudson for his kind hospitality, and the party soon afterwards dispersed. The stream of cyclists, sixteen in number, the majority being ladies, passing rapidly along the winding road in Mr. Hudson's park, was a pretty sight. A few drove, and others walked back to Knebworth Station. The cyclists returned by Bragbury, Knebworth Station, Woolmer Green, and Welwyn, and then made a *détour* by Ayot St. Peter and Ayot Green into the Great North Road again, and thence by Hatfield to St. Albans, a few going on to Watford.

Field Meeting, 1st July, 1899.

REDBOURN AND THE AUBREYS.

This was a joint meeting with the St. Albans Architectural and Archæological Society, and was under the direction of Sir John Evans, K.C.B., F.R.S. The members of the two Societies met at

Foster's Farm on the road from Redbourn to Hemel Hempstead, and, by kind permission of Mr. Farr, the occupier of the farm, who accompanied them, proceeded to view the old fortified camp known as the Aubreys.

The camp, which has an area of about twenty acres, is roughly oval in form, with a fosse from nine to thirteen feet deep and from forty-five to sixty feet wide. In some places the mounds are double, and at the south end the earthwork has been levelled so as to form a suitable site for the farmhouse and homestead. Excavations are being made in various places on the site by the Rev. Lewis Browne, Vicar of Redbourn, but nothing has yet been found which throws any light upon the age of the camp.

The party having assembled under a shed near the farm, Sir John Evans made a few remarks on the camp. It was, he said, a very extensive earthwork, and it would be desirable to ascertain its date. It was not Roman, and he was inclined to regard it as pre-Roman, for it resembled many camps which were known to belong to that early period. At Maiden's Bower, near Dunstable, for instance, which was not far distant, many stone arrow-heads and scrapers of flint have been found, showing that to belong to the Stone Age. The chief objection to regarding this camp as pre-Roman was that it lies so low, such camps being usually on the top of a hill, but there might be reasons for the construction of this one on low ground, such as facility in obtaining a supply of water. He hoped that the excavations which were being carried on by Mr. Browne would prove successful, and that something might be found which would throw light upon its origin. What appeared to be a coin had been found which was in fact a Nuremberg counter of the fifteenth century, an Elizabethan threepenny-piece, dated 1578, and two seventeenth-century tradesmen's tokens, one for James Hannell, of Redbourn, struck in 1669, and another for John Halsey, of the Black Lion, in the same village. There is no "Black Lion" there now, but there is a "Red Lion," and Sir John suggested that perhaps it was the same inn but had been boiled like a lobster. Referring to the derivation of the name "Aubreys," he said that it was merely a corruption of Old Burys or Old Burghs, meaning an old place. There were two parishes in the county the name of which was similarly derived, viz. Aldbury and Albury.

Sir John Evans then related the story of the invention of St. Amphibalus as recorded by Matthew Paris. In olden times there were two mounds near Redbourn, known as the "Hills of the Banners." A St. Albans man dreamed that St. Alban appeared to him and pointed out one of these hills as the tomb of his master, St. Amphibal. Excavations were made and his dream was confirmed by the discovery of the skeleton of the saint, together with those of three of his friends. A paper on the antiquities of the neighbourhood of St. Albans was read before the Society of Antiquaries in 1849, in which Mr. Thomas Wright showed that these barrows belonged to Saxon times, and that the bones must

have been those of some old pagan Saxon warrior, but to the belief that the bones of St. Amphibalus had been found we owed the existence of the beautiful fragments of the shrine of that saint in St. Albans Abbey. He was believed to be a friend, and not merely the cloak of St. Alban.

The party then proceeded to view the church, the Vicar stating that it was formerly dedicated to St. Amphibalus, as old people now remember, but that it is now dedicated to St. Mary. It was, he said, an old Norman church. Canon Davys considered that it was the Priory church, but Mr. Browne did not agree with this view, thinking that it was the Parish church, dating from about 1110. Of the original Norman church the tower and the north aisle only remained. There was at one time a low-pitched roof, the line of which can be traced round the nave below the clerestory. In the Decorated period the church was much altered, the chancel being lengthened, the Norman apse removed, the sedilia erected, and the side windows enriched. The south aisle was lengthened by Abbot John of Wheathampstead about the middle of the fifteenth century, an arch being opened in the wall so as to form the extended aisle into a chapel which was dedicated to St. Amphibalus.

Mr. Browne then stated that the most interesting feature of the church as it now exists was the double-canopied screen, which is beautifully carved, but he did not know when or by whom it was erected; part of it, he said, certainly belonged to the Decorated period. It is in a very good state of preservation. He regretted the absence of the old Norman font, which could not be found. The brasses, he said, were few and unimportant, the date of the oldest one being 1470.

The Communion-plate was then shown, and Mr. Browne said that it was Elizabethan, being dated 1577, at which time the original handsome vessels were removed and these inexpensive ones supplied.

After according votes of thanks to Sir John Evans, the Rev. Lewis Browne, and Mr. Farr, the party dispersed.

Field Meeting, 15th July, 1899.

THE WHEATHAMPSTEAD DISTRICT.

Again the Natural History and Archæological Societies joined their forces, this time to attack chiefly the interesting problems connected with the Devil's Dyke and the Moat. The meeting was under the direction of Mr. Hopkinson.

A good party of cyclists assembled at Wheathampstead Church, and there awaited the arrival of a train which brought considerable reinforcements. The united party first inspected the Church and the Rectory garden under the guidance of the Rev. Canon Davys. The chief feature in the Canon's garden is the great variety of ferns which he grows, and which appear to thrive well with the careful

attention and abundance of water with which they are provided. There are several rare species and striking varieties.

A walk was then taken through Marford to the Devil's Dyke, which was traced for some distance southwards from the valley of the Lea. Opinion was divided as to the origin of this narrow glade, some members thinking it to be a Celtic tribal boundary, while the Director ventured the suggestion that as it slopes gradually downwards to the ford over the Lea, it might have been cut merely for a roadway or for an opening to drain the land, for a considerable tract of which it appears to form an outlet for any water which might accumulate. That it was not intended for defensive purposes appears to be shown by the earth from it not being heaped up on one side only, which is usually the case in such earthworks. It is more likely that it was a tribal boundary, for it now forms part of the boundary between the parishes of Sandridge and Wheathampstead, and between the Hundreds of Cassio and Dacorum.

The "slad" or moat, another earthwork now filled with water, which lies a short distance to the east, was then visited, the farm-buildings of Lower Beech Hyde being passed on the way. This farm and Upper Beech Hyde probably derived their names from these excavations, and not from the beech-tree, for the word "beach" was formerly used not only for the sea-shore but for any bank. This is the origin of the name "Beech Bottom," and it may be that that old earthwork had some connection with the Wheathampstead Devil's Dyke, for this is but one of many such dykes, which, when superstition prevailed and faith was strong, were ascribed to his Satanic majesty.

Ending the discussion upon the origin of these and other similar earthworks without arriving at any definite conclusion, the party proceeded to Coleman Green, where was seen the chimney of the old cottage in which John Bunyan used to stay, and in which it is said that he preached. Nothing now remains of the three cottages which formerly stood on this spot but this picturesque ivy-covered chimney-stack, to which a commemorative slab has been attached. A pleasant walk down the old road to Cromer Hyde was then taken, and tea was partaken of in the orchard of the village inn. After tea some members cycled round, and others walked across, the park and gardens of Brocket Hall, by kind permission of Lord Mount Stephen, to Waterend House. This is an old gabled mansion, now used as a farmhouse, which tradition assigns as the birthplace of the famous and beautiful Sarah, Duchess of Marlborough. There is nothing of interest in it now except the long room at the top, which once extended from one end of the house to the other, but it is a picturesque old red brick and tiled structure well worth seeing.

Here the party dispersed, a few walking to Ayot Station and the majority cycling by way of Lemsford to their respective destinations.

213TH ORDINARY MEETING, 28TH NOVEMBER, 1899, AT WATFORD.

WILLIAM WHITAKER, B.A., F.R.S., Pres. G. S., Assoc. Inst. C.E., Vice-President, in the Chair.

Mr. F. W. Adams, Constance Villa, Watford; Mr. W. Bickerton, The Hawthorns, Watford; Mr. C. A. Rumboll, Nutley, Watford; Mr. F. R. Sheehan, Hillside Road, St. Albans; and Mr. Alfred Sutton, Assoc. Royal School of Mines, Waterslade, Watford, were proposed for membership of the Society.

The following paper was read:—

"The Gravels, Sands, Clays, and Loams of Western Hertfordshire." By T. E. Lones, M.A., LL.D., B.Sc. (*Transactions*, Vol. X, pp. 153–164.)

A discussion ensued in which the President, Mr. Hopkinson, and Mr. W. R. Carter took part, and Dr. Lones, in replying, said that he hoped to read a paper on the speculative side of the subject at a future meeting.

The paper was illustrated by a coloured map, longitudinal sections, drawings, and specimens of rocks and fossils.

SPECIAL MEETING, 28TH NOVEMBER, 1899.

(AT WATFORD.)

WILLIAM WHITAKER, B.A., F.R.S., etc., Vice-President, in the Chair.

This meeting was convened for the purpose of considering and passing certain alterations in the Rules of the Society proposed by the Council. Mr. Hopkinson explained the object of the alterations, by several of which he said the frequent repetition of the word Watford would be obviated in order to remove the impression which the rules at present conveyed that the Society was a purely local one, and not with the intention of holding fewer meetings at Watford. As the Society's collections, other than its library, had been presented, with the consent of the Trustees, to the County Museum at St. Albans, the office of Curator became a sinecure and it was proposed to abolish it, substituting the office of Editor, which hitherto had not been recognized although it had existed from the foundation of the Society. A few other minor alterations were also explained. He then read the Rules with the revisions proposed, and they were put to the meeting *seriatim* and carried, with a slight verbal alteration in Rule IV.

The revised Rules, which it was resolved should come into operation at the next Anniversary meeting, will be issued with the next part of the 'Transactions.'

214TH ORDINARY MEETING, 16TH JANUARY, 1900, AT WATFORD.

PROFESSOR ATTFIELD, M.A., Ph.D., F.R.S., F.C.S., Vice-President, in the Chair.

Mr. F. W. Adams, Mr. W. Bickerton, Mr. C. A. Rumboll, Mr. F. R. Sheehan, and Mr. Alfred Sutton, A.R.S.M., were elected Members of the Society.

Miss Alice Hibbert-Ware, St. Margaret's, Bushey, was proposed for membership.

Mr. E. T. Burr and Mr. J. K. Riggall were elected Auditors of the Accounts for the year 1899.

The Chairman alluded to the death, on the 14th inst., of Mrs. James Hopkinson, of Watford, whereby he said the Society had lost one of its original members, and spoke of the deep sympathy which all members of the Society would feel with her son, Mr. John Hopkinson, in the loss which he had sustained; and on the proposition of Mr. W. R. Carter, seconded by Mr. W. Lepard Smith, a vote of condolence with Mrs. Hopkinson's family was passed.

The following paper was read:—

"Notes on the Place-names and Field-names of the Parish of Watford." By Percy Manning, M.A., F.S.A. (*Transactions*, Vol. X, pp. 193–212.)

In the absence of the Author the following Report was taken as read:—

"Report on the Conference of Delegates to the British Association at Dover in 1899." By John Hopkinson, F.L.S., F.G.S., Assoc. Inst. C.E., Hon. Sec.

The meetings of the Conference were held on the 14th and 19th of September. The President of the Society, Mr. William Whitaker, F.R.S., had been nominated Delegate, but in his absence the Society was represented by its Honorary Member, Mr. G. J. Symons, F.R.S., a member of the Corresponding Societies' Committee, who attended both meetings of the Conference.

The Rev. T. R. R. Stebbing, F.R.S., the Chairman nominated by the Council of the Association, presided at both meetings.

First Meeting.

Coast Erosion.—The Report of the Corresponding Societies' Committee stated that the resolution passed last year respecting the desirability of securing the co-operation of the Coastguard for carrying on systematic observations on coast-erosion had been adopted by the British Association and favourably received by the Admiralty, and that the necessary forms prepared by a Committee of the Council had been issued, many having already been returned filled in by the Coastguard. Copies of the forms were appended to the Report.

The Living Subterranean Fauna of Great Britain and Ireland.—The Chairman delivered an Address on the animals which live in caves and wells. He stated that very little was known of such animals in this country, although they had been well worked out on the Continent of Europe, in America, and in New Zealand. "Picard," he said, "enumerates 308 European cave-animals and

102 American. This total of 410 includes a few Protozoa, a sponge, two hydras, a few worms, one mollusc, several crustaceans and myriapods, numerous arachnids, and a host of Coleoptera, the other insects being chiefly Thysanura. The vertebrates are limited to four American fishes and one European batrachian, the celebrated *Proteus anguineus*." The well-fauna of England and Ireland includes four species of amphipods; *Tinea ustella* has been found in a disused coal-mine near Glasgow; and a copepod has been described from a Northumbrian coal-mine. The distribution of the well-shrimp (*Niphargus*) is known for the neighbourhood of Dublin and for the whole south of England from Devonshire to Kent. It may be added that it occurs in wells in Hertfordshire.

Referring to the theory that at one time the globe was overspread with a blind fauna, the remnants of which have been preserved in deep waters and dark holes, whither creatures endowed with sight have as a rule not cared to follow them, Mr. Stebbing said that it would be interesting to know how that theory explains the possession of eye-stalks by a sightless prawn.

In conclusion Mr. Stebbing said: "It will indeed be extraordinary if the caverns and springs and artesian borings in Great Britain and Ireland do not yield, to a united effort of investigation, a fauna in some degree comparable in interest with that which, under similar circumstances, has been and is being found in other parts of the globe. It will be extraordinary if the research, whatever its direct results, does not stimulate, in many of those who pursue it, highly pleasurable and profitable activities both of body and mind. At the worst, if the old proverb may be trusted, while groping for creatures at the bottom of a well, you will always have the chance of combining two enjoyments, fishing for amphipods and finding Truth."

A discussion ensued, and Mr. Stebbing, in reply to a question as to the best way of catching the well-shrimp, said that it was best to wait until the well was almost empty, and then to let down a bucket and withdraw it as quickly as possible, lest the creatures, being scared, should have time to get away. Sometimes well-shrimps were brought up when pumping was going on.

Second Meeting.

The meeting opened with a debate on the organization and development of the local Societies, and as to how the meetings of the Conference could be made most useful to the Societies represented.

The National Trust.—Mr. Hugh Blakiston, Secretary of the National Trust for Places of Historic Interest or Natural Beauty, read a paper on the aims and work of the Trust. He remarked that the National Trust was incorporated in 1894 as a Limited Liability Company "to promote the permanent preservation, for the benefit of the nation, of lands and tenements (including buildings) of beauty or historic interest; and, as regards lands, to preserve (so far as practicable) their natural aspect, features, and animal- and plant-

life; and for this purpose to accept, from private owners of property, gifts of places of interest or beauty, and to hold the land, houses, and other property thus acquired, in trust for the use and enjoyment of the nation."

Mr. Blakiston then touched upon the wealth of the British Isles in buildings of historic interest, and on the non-existence here of a Minister of State one of whose functions was their preservation. The extraordinary growth in the size of our towns during the reign of Queen Victoria had made the last fifty years a peculiarly disastrous period as regards the destruction of ancient monuments, apart from such destruction as altered circumstances had made inevitable. Children were therefore now brought up with little or nothing around them to stimulate their imaginations, or to help them to realize the history of the past. And these islands were looked upon as "home" by millions of people scattered over the face of the earth, who might fairly expect to find that the ancient monuments existing only in the centre of the British Empire were carefully preserved by those dwelling around them.

He then referred to some of the work already done by the Trust. It had purchased Barras Head opposite Tintagel Castle, and a most beautiful cliff overlooking Barmouth had been presented to it by a lady. Toys' Hill, near Oxted, Kent, and Ide Hill in the same district, had also been acquired. The purchase and restoration of the old Clergy House at Alfriston, Sussex, and of Joiner's Hall, Salisbury, had secured to the nation two fine specimens of mediæval domestic architecture. The Falkland monument on the battlefield at Newbury, Berks, was also under the care of the Trust. And it had recently purchased in Wicken Fen, Cambridgeshire, a piece of the primitive fenland, which will remain for ever undrained and untouched, with its original plant- and animal-life.

The task before them, he said, was one which could not be achieved either by a national society acting by itself or by local societies acting by themselves. No central society could possess the full and complete information in a given case which some local society possessed, nor could it influence local feeling to the same degree. On the other hand, no local society is so fully in touch with Parliament or can appeal to so large a public as a great central society. Coming to practical details, the two important points were the creation of local committees to watch over the ancient monuments of each county or district, and the formation of a central fund. The Trust experienced much difficulty in obtaining timely information, and thought that a federation of local societies would provide machinery to obviate this difficulty. The creation of a central fund would enormously strengthen the hands of the federated societies, by enabling their representatives to purchase properties of national interest, or to make grants towards their purchase. With a small subscription and a large membership a very considerable sum might be raised, from which grants could be made in local cases. The details of the scheme would of course require careful consideration, and he would be

glad to receive any suggestions regarding them from members of the Conference.

A discussion followed the reading of the paper, and Mr. Blakiston, in reply to questions, said that there was another society for the protection of ancient buildings, but it had no power to hold buildings as the National Trust had, and it could only intervene when an ancient building was in danger of being injured. The Trust was in close touch with that society, and also with the Commons Preservation, the Selborne, and other societies. The authorities of the Trust were about to make a proposal for federation to the natural history and archæological societies of the country.

Geological Photographs. — Professor W. W. Watts said that the Committee for the Collection, Preservation, and Systematic Registration of Photographs of Geological Interest, of which he was Chairman, would be glad to receive any contributions of such photographs. The Committee hoped to be able to undertake the publication of typical geological photographs with letterpress descriptions in such a way as to render them easily obtainable by those who could make good use of them. It would greatly help the Committee if local societies would agree to purchase a series of these photographs. There was also a duplicate collection of prints and lantern-slides which could be sent to any local society wishing to exhibit them, the only expense incurred being that of carriage.

Distribution of Mosses. — Mr. Harold Wager informed the Delegates that Section K (Botany) had appointed a Committee to consider the geographical distribution of mosses, a matter of interest to all the local societies.

Appendix.

The following is a list of the Committees of the British Association appointed by the General Committee to which assistance may be given by Provincial Scientific Societies, with the names and addresses of their Secretaries :—

The Application of Photography to the Elucidation of Meteorological Phenomena. — A. W. Clayden, M.A., F.G.S., St. John's, Polsloe Road, Exeter.

Seismological Observations.—John Milne, F.R.S., Shide Hill House, Shide, Isle of Wight.

Investigation and Preservation of the Erratic Blocks of the British Isles.—Professor P. F. Kendall, F.G.S., Yorkshire College, Leeds.

The Collection, Preservation, and Systematic Registration of Geological Photographs.—Professor W. W. Watts, M.A., Sec.G.S., Mason Science College, Birmingham.

The Teaching of Natural Science in Elementary Schools.—Professor H. E. Armstrong, Ph.D., F.R.S., 55, Granville Park, Lewisham, S.E.

The Present State of Anthropological Teaching.—H. Ling Roth, 32, Prescot Street, Halifax.

The Collection, Preservation, and Systematic Registration of Anthropological Photographs.—John L. Myers, M.A., F.S.A., Christ Church, Oxford.

25TH ANNIVERSARY MEETING, 20TH MARCH, 1900.
(AT WATFORD.)

The RIGHT HONOURABLE THE EARL OF VERULAM, President, in the Chair.

The Report of the Council for 1899, and the Treasurer's Account of Income and Expenditure, were read and adopted.

Thomas McKenny Hughes, M.A., F.R.S., F.S.A., F.G.S., Professor of Geology in the University of Cambridge, was elected an Honorary Member of the Society.

The President delivered an Address. (*Transactions*, Vol. X, pp. 165–168.)

The following gentlemen were duly elected as the Officers and Council for the ensuing year :—

President.—The Right Honourable the Earl of Verulam.

Vice-Presidents.—John Attfield, M.A., Ph.D., F.R.S., F.C.S., F.I.C.; Alan F. Crossman, F.L.S., F.Z.S., M.B.O.U.; Sir John Evans, K.C.B., D.C.L., LL.D., Sc.D., V.P.S.A., etc.; William Whitaker, B.A., F.R.S., F.G.S., Assoc. Inst. C. E.

Treasurer.—John Weall.

Honorary Secretaries.—W. R. Carter, B.A.; A. E. Gibbs, F.L.S., F.R.H.S.

Editor.—John Hopkinson, F.L.S., F.G.S., F.R.M.S., F.R. Met. Soc., Assoc. Inst. C. E.

Librarian.—Daniel Hill.

Other Members.—Edward M. Chater; Alfred E. Cox, M.R.C.S., L.R.C.P.; Arthur E. Ekins, F.C.S., F.I.C.; Thomas E. Lones, M.A., LL.D., B.Sc.; John Morison, M.D., F.G.S., D.P.H.; J. K. Riggall; George Rooper, F.Z.S.; James Saunders, A.L.S.; F. W. Silvester; W. Lepard Smith; G. H. Wailes, Assoc. M. Inst. C.E.

The thanks of the Society were accorded to Mr. George Rooper, F.Z.S., retiring from the office of Vice-President; to Mr. John Hopkinson, F.L.S., retiring from the office of Honorary Secretary; to Mr. A. E. Gibbs, F.L.S., retiring from the office of Curator; and to Mr. Charles Ashdown, Mr. F. C. Mahon, Mr. George P. Neele, and Mr. William Page, retiring from the Council.

The following resolution, proposed in eulogistic terms by Professor Attfield, and seconded by Mr. W. R. Carter, was carried unanimously :—"That the best thanks of the Members of the Hertfordshire Natural History Society and Field Club be given to Mr. John Hopkinson for his services as Secretary from the inauguration of the Society in 1875 to the present year 1900, and that he be requested to accept an Address from the members expressive of their appreciation of the long-sustained, skilful, and unselfish devotion of his time and energies to the best interests of the Society."

Mr. Hopkinson, in expressing his thanks to the members for this resolution, reminded them that his services as Secretary had

not been quite continuous during this period, as he ceased to be Secretary while being President for two years, and for a few years afterwards. He would still continue to do his best for the interests of the Society.

Report of the Council for the Year 1899.

In presenting the 25th Annual Report, the Council of the Hertfordshire Natural History Society has the pleasure of announcing that the slight falling-off in the number of members during the last few years seems to have come to an end, there being an increase of two in the year 1899. Although there is no indication of increasing interest in the evening meetings, the field meetings, which were more numerous than usual, have generally been well attended, this being in great measure due to each having been arranged for the convenience of cyclists.

During the year fourteen ordinary members have been elected; one member has compounded for his annual subscription; nine members have resigned; and the Council regrets to have to record the loss of three members by death—Sir William Flower, an Honorary Member; Mr. George Pearson, a life member; and Mrs. Osborne, an annual subscriber.

Sir William Henry Flower, K.C.B., D.C.L., F.R.S., President of the Zoological Society, died on the 1st of July, aged 68. Educated for the medical profession, he gave up practice in 1861 on being appointed Curator of the Hunterian Museum. Eight years later he became Hunterian Professor, and in 1884 he relinquished both these posts to succeed Professor Owen as Director of the Natural History Museum, which office he held until about a year before his death. He did much good zoological work, but is best known as our chief authority on natural history museums, and on the methods by which such museums may be made educationally useful. He was elected an Honorary Member of the Society in 1893.

Mr. George Pearson died at Brickendonbury on the 3rd of March, aged 65. Until a few years ago he was head of the firm of S. Pearson & Son, the well-known contractors and engineers, who have carried out many great undertakings in all parts of the world. A large number of Roman coins were found on his estate some years ago and were described in our 'Transactions' by Sir John Evans (Vol. IX, p. 169), Mr. Pearson making a donation to the Society to cover the cost of illustration.

The census of the Society at the end of the years 1898 and 1899 was as follows:—

	1898.	1899.
Honorary Members	16	15
Corresponding Members	3	3
Life Members	46	46
Annual Subscribers	137	140
	202	204

The following papers have been read at Watford during the year:

Jan. 17.—On some Changes along our Coasts; by William Whitaker, B.A., F.R.S., Pres.G.S.

—— Report on the Conference of Delegates to the British Association at Bristol in 1898; by John Hopkinson, F.L.S., F.G.S., etc.

Feb. 28.—Anniversary Address—Geological and other Work in Hertfordshire; by the President, William Whitaker, B.A., F.R.S., Pres.G.S., Assoc. Inst. C.E.

March 28.—Report on the Rainfall in Hertfordshire in the Year 1898; by John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc. Inst. C.E.

—— Meteorological Observations taken in Hertfordshire in the Year 1898; by John Hopkinson.

—— Report on the Mycetozoa of the South Midlands for the Years 1895 to 1898; by James Saunders.

—— Report on Phenological Phenomena observed in Hertfordshire during the Year 1898; by Edward Mawley, Sec. R. Met. Soc., F.R.H.S.

—— Notes on Birds observed in Hertfordshire during the Year 1898; by Alan F. Crossman, F.L.S.

Nov. 28.—The Gravels, Sands, Clays, and Loams of Western Hertfordshire; by T. E. Lones, M.A., LL.D., B.Sc.

The following lecture was delivered at St. Albans:—

March 23.—Colour in Nature; by Wilfred Mark Webb, F.L.S.

The following Field Meetings were held during the year:—

May 13.—Knebworth Park.

—— 27.—Bushey, Watford Heath, and Harrow Weald.

June 10.—Rickmansworth and Harefield.

—— 24.—Shephall, Aston, and Frogmore Hall.

July 1.—Redbourn and the Aubreys.

—— 15.—Wheathampstead, Coleman Green, Brocket Park, and Waterend House.

The meetings on the 27th of May and the 10th of June were held in conjunction with the Geologists' Association, and those on the 1st and 15th of July in conjunction with the St. Albans and Herts Architectural and Archæological Society. A few members availed themselves of an invitation to join the Geologists' Association in a cycling excursion on the Chiltern Hills beyond West Wycombe on the 8th of July.

The Society is indebted to Lord Strathcona and Mount Royal for permission to visit the private grounds of Knebworth House on the 13th of May; to Mrs. Heathcote for permission to pass through the park of Shephalbury on the 24th of June; to Mr. G. B. Hudson, M.P., for kindly entertaining the members at Frogmore Hall on that date; and to Lord Mount Stephen for permission to cross Brocket Park and pass through his private grounds from Cromer Hyde to Waterend House on the 15th of July.

Three parts of the tenth volume of the present series of the Society's 'Transactions,' containing 120 pages and two plates, have been published during the year, completing the publication of the papers read during the session 1898–99. It may be some time before another part is published, as there has not been, until to-night, sufficient material in hand for one, unless it be for the

reports of the proceedings, including the field meetings, which are only waiting for your Editor to find time to compile them.

The funds of the Society are not quite in such a satisfactory condition as they were at the end of the preceding year, for the balance in hand is a little smaller although a life composition has been received and not invested, the expenditure exceeding the ordinary income by about £7.

The librarian reports that the additions to the library have been about the average. With the assistance of Dr. Lones he has made a slip-catalogue of both the bound and unbound works in the library, noting all missing parts of serial publications. A manuscript catalogue of the whole of the bound volumes has been prepared, and this will form the basis of a printed catalogue when the funds of the Society will allow of the expense of printing one. He wishes to take this opportunity of acknowledging his indebtedness to Dr. Lones, without whose help he would have been unable to carry this work through. He regrets to have to state that nearly thirty works in former catalogues are missing.

A special meeting was held on the 28th of November in order to make a few alterations in the Rules. The Society's collections, other than its library, having been presented to the Hertfordshire County Museum, with the consent of the Trustees and the approval of the members, the office of Curator became a sinecure, and it was resolved to abolish it. It was also thought desirable to dissociate the office of Editor from that of Secretary, leaving, by these two alterations, the number of officers the same as before. It was made possible to hold elsewhere certain meetings which hitherto could be held only at Watford; balloting for the election of members was made contingent upon a ballot being demanded; and the Council was authorized to have published in the 'Transactions' the results of any investigation of a scientific nature relating to Hertfordshire undertaken at its request without such results being brought before any meeting.

The opening of the Hertfordshire County Museum is the most important local event in the year of interest to the members of the Society. The land at St. Albans on which the Museum is erected having been given by Earl Spencer, the foundation-stone was laid by Lady Evans, and on the 15th of November Lady Cowper declared the Museum to be open. Although not officially connected with either the Hertfordshire Natural History Society or the St. Albans Archæological Society, except that both these Societies are represented on the Executive Committee, it is perhaps not too much to say that the Museum may be considered to be the outcome of the harmonious working of the principal officers of these Societies to achieve a result which should conduce to the furtherance of the objects which both Societies are interested in promoting. The Museum has been well attended for a place the size of St. Albans, the number of persons visiting it since the opening having averaged 175 per week.

INCOME AND EXPENDITURE FOR THE YEAR 1899.

Dr.	£	*s.*	*d.*	Cr.	£	*s.*	*d.*
To Balance from 1898	9	17	0	By Printing 'Transactions'	41	9	7
,, Entrance Fees	3	10	0	,, Miscellaneous Printing	4	7	3
,, Subscriptions for 1897	1	0	0	,, Expenses of Meetings	4	7	6
,, ,, ,, 1898	4	0	0	,, Library Expenses	5	19	0
,, ,, ,, 1899	49	0	0	,, Salary of Assistant	5	0	0
,, ,, ,, 1900	6	0	0	,, Postages	10	14	4
,, Life Composition Fee	5	0	0	,, Stationery and Sundries	4	8	5
,, Dividends on £130 India 3 per cent. Stock	3	18	0	,, Fire Insurance	0	12	6
,, Sale of Publications ('Flora of Hertfordshire' 18*s.*; 'Transactions' £1 16*s.*, less expenses)	2	14	0	,, Balance at Bank	8	0	5
	£84	19	0		£84	19	0

Amount invested in the purchase of £130 India 3 per cent. Stock . . . . £126 15*s.* 6*d.*

Audited and found correct this 28th day of February, 1900, { EDWD. THOS. BURR, J. KIRKBY RIGGALL.

Additions to the Library in 1899.

Presented.

Title.	Donor.
British Association for the Advancement of Science. Report for 1898. Bristol. 8vo. London, 1899 .	*The Association.*
British Museum. Systematic List of British Oligocene and Eocene Mollusca in the Collection. 8vo. London, 1899	*The Trustees of the Museum.*
Duncan, P. Martin. The Transformations of Insects. 8vo. London, 1898	*Sir John Evans.*
Geikie, James. The Great Ice Age. 8vo. London, 1874	,,
Symons, G. J. (Ed.). Monthly Meteorological Magazine. Vol. xxxiv. 8vo. London, 1899	*The Editor.*

Received in Exchange.

American Museum of Natural History. Report for the Year 1898. 8vo. New York, 1899.

———. Bulletin. Vol. xi, part 2. *Ib.*

Barrow Naturalists' Field Club. Annual Report and Proceedings. Vol. xiii. 8vo. Barrow, 1899.

Bath Natural History and Antiquarian Field Club. Proceedings. Vol. ix, part 2 8vo. Bath, 1899.

Boston Society of Natural History. Proceedings. Vol. xxix. 8vo. Boston (U.S.A.), 1899.

Bristol Naturalists' Society. Proceedings. Vol. viii, part 3. 8vo. Bristol, 1899.

Cardiff Naturalists' Society. Report and Transactions. Vol. xxx. 8vo. Cardiff, 1899.

Croydon Microscopical and Natural History Club. Transactions, 1898–99. 8vo. Croydon, 1899.

Edinburgh. Botanical Society. Transactions and Proceedings. Vol. xxi, part 1. 8vo. Edinburgh, 1899.

——— Geological Society. Transactions. Vol. vii, part 4. 8vo. Edinburgh, 1899.

Glasgow, Philosophical Society of. Proceedings. Vol. xxx. 8vo. Glasgow, 1899.

London, Geological Society of. Abstracts of the Proceedings. Session 1898–99. 8vo. London, 1899.

———. Geologists' Association. Proceedings. Vol. xvi, parts 1–5. 8vo. London, 1899.

———. Quekett Microscopical Club. Journal. Vol. vii, Nos. 44, 45. 8vo. London, 1899.

———. Royal Meteorological Society. Quarterly Journal. Vol. xxv. 8vo. London, 1899.

———. Royal Microscopical Society. Journal. 1899. 8vo. London, 1899.

Manchester Field-Naturalists' Society. Report and Proceedings for the Year 1898. 8vo. Manchester, 1899.

——— Geographical Society. Journal. Vol. xiv, parts 7–12. Vol. xv, parts 1–9. 8vo. Manchester, 1899.

——— Geological Society. Transactions. Vol. xxvi, parts 1–9. 8vo. Manchester, 1899.

——— Literary and Philosophical Society. Memoirs and Proceedings. Vol. xliii, parts 1–4. 8vo. Manchester, 1899.

New York Academy of Sciences. Proceedings. Vol. xi, part 3. Vol. xii, part 1. 8vo. Lancaster, Pa., 1899.

New York State Museum of Natural History. 49th Annual Report (for 1895). 8vo. Albany, N.Y., 1899.
——— ———. Report of State Geologist and Field Naturalist. 4to. Albany, N.Y., 1898.
Norfolk and Norwich Naturalists' Society. Transactions. Vol. vi, part 5. 8vo. Norwich, 1899.
Northamptonshire Natural History Society. Journal. Nos. 73-76. 8vo. Northampton, 1898.
Philadelphia Academy of Natural Sciences. Proceedings. 1899, parts 1–3. 8vo. Philadelphia, 1899.
Rugby School Natural History Society. Report for the Year 1898. 8vo. Rugby, 1899.
Somersetshire Archæological and Natural History Society. Proceedings. Vol. xlv. 8vo. Taunton, 1899.
United States Department of Agriculture. North American Fauna. Bulletin, No. 14.—Jumping Mice. 8vo. Washington, 1898.
——— Geological Survey. 18th Annual Report. Part 1.—Director's Report. Part 2.—Papers chiefly of a Theoretic Nature. Part 3.—Economic Geology. Part 4.—Hydrography. Part 5.—Mineral Resources of the United States. Metallic Products and Coal. Non-metallic Products except Coal. 8vo. Washington, 1897-98.
——— ———. 19th Annual Report. Part 1.—Director's Report. Part 4.—Hydrography. Part 6.—Mineral Resources of the United States, 1897. Metallic Products and Coal. Non-metallic Products except Coal. 8vo. Washington, 1898–99.
——— ———. Monographs. Vol. xxix.—Geology of Old Hampshire Co., Mass., by B. K. Emerson. Vol. xxxi.—Geology of Aspen Mining District, Colorado, by J. S. Spurr; with folio Atlas. Vol. xxxv.—The Later Extinct Floras of North America, by J. S. Newberry. 4to. Washington, 1898.
Upsala University Geological Institute. Bulletin. Vol. iv, part 1. 8vo. Upsala, 1899.
———. Bidrag till en Lefnadsteckning öfver Carl von Linné, vii. *Ib.*
Washington, U.S.A. Smithsonian Institution. Annual Report for the Year ending 30th June, 1898. 8vo. Washington, 1898.
Wiltshire Archæological and Natural History Society. Magazine. Vol. xxx, Nos. 91, 92. 8vo. Devizes, 1898.
———. Inquisitiones Post Mortem, Charles I, part 7. *Ib.*, 1899.
Wisconsin Academy of Science, Arts, and Letters. Proceedings. Vol. xii, part 1. 8vo. Madison, 1898.
Yorkshire Geological and Polytechnic Society. Proceedings. Vol. xiii, part 4. 8vo. Leeds, 1899.
——— Naturalists' Union. Naturalist. N.S. Vol. xxiv. 8vo. Leeds, 1899.

Purchased.

Botany, Journal of. Vol. xxxvii. 8vo. London, 1899.
Buckler, W. (the late). The Larvæ of the British Butterflies and Moths. Vol. viii. Geometræ, Part 2. (*Ray Society.*) 8vo. London, 1899.
Home Counties Magazine. Vol. i. 8vo. London, 1899.
Nature Notes. Vol. x. (*Selborne Society.*) 8vo. London, 1899.
Novitates Zoologicæ. Vol. vi. 8vo. Tring, 1899.
Year-book of the Scientific and Learned Societies of Great Britain and Ireland. . . . 1898. 8vo. London, 1899.
Zoologist. 4th Series. Vol. iii. 8vo. London, 1899.

215TH ORDINARY MEETING, 10TH APRIL, 1900, AT WATFORD.

ALAN F. CROSSMAN, F.L.S., F.Z.S., Vice-President, in the Chair.

Miss A. Hibbert-Ware was elected a Member of the Society.

The following papers were read :—

1. "Report on Phenological Phenomena observed in Hertfordshire during the Year 1899." By Edward Mawley, Sec. R. Met. Soc., F.R.H.S. (*Transactions*, Vol. X, pp. 173–179.)

2. "The Habitats of the Mycetozoa." By James Saunders, A.L.S., and E. Saunders. (*Transactions*, Vol. X, pp. 169–172.)

3. "Notes on Lepidoptera observed in Western Hertfordshire in 1897, 1898, and 1899." By Arthur Cottam, F.R.A.S. (*Transactions*, Vol. X, pp. 185–190).

4. "A Curious Instance of the Labour-saving Instinct in the Leaf-cutting Bees." By Aubrey C. Stoyel. (*Transactions*, Vol. X, pp. 191–192.)

5. "Notes on Birds observed in Hertfordshire during the Year 1899." By Alan F. Crossman, F.L.S., F.Z.S., M.B.O.U. (*Transactions*, Vol. X, pp. 180–184.)

6. "Notes on Curious Nesting-places." Communicated by John Hopkinson, F.L.S. (*Transactions*, Vol. X, p. 192.)

FIELD MEETING, 5TH MAY, 1900.

ARLESEY AND HITCHIN.

This meeting was held in conjunction with the Geologists' Association, and was under the direction of Mr. William Hill, F.G.S. The members of that Association came by train to Three Counties Station with some members of the Hertfordshire Society, others cycling from Watford and St. Albans.

A large pit near the station, where "coprolites" were formerly dug, but now worked for brick-making, was first visited. Little is now to be seen but the Gault clay from which bricks are made, but for a short distance on the eastern side of the pit there is a section showing the base of the Chalk Marl, the Cambridge Greensand which is here very thin, and the Gault. Remarks upon the section were made by Mr. W. Whitaker, F.R.S., who stated that the Greensand had evidently been deposited upon an eroded surface of the Gault, for although its base was well defined, the surface of the Gault on which it rested was uneven. Most of the fossils which it contained were derived from the Gault, but some were contemporaneous with its formation, and their affinities being more with the fauna of the Chalk than with that of the Gault, the bed was regarded as the base of the Chalk. The Gault is here exposed to a depth of about fifty feet, and is unfossiliferous.

The party then took a field-path to the Arlesey Cement Works, a rather awkward one for the cyclists owing to the stiles on the way. The section seen here is a continuation upwards of that

exposed in the other pit, showing about 70 feet of bluish-grey Chalk Marl, the Totternhoe Stone, and a few feet of the Lower Chalk above it. The Director said that there was a considerable difference between the white marl immediately above the Cambridge Greensand and the bluish-grey marl here seen, that containing little more than 25 per cent. of argillaceous matter and this nearly 50 per cent., but here it was rather more argillaceous than usual, and it passed rapidly upwards into a more calcareous and less argillaceous deposit. The Totternhoe Stone here, he said, consists of two rough and sandy beds together about 12 feet thick, and is not suitable for building purposes as is that at Totternhoe. The distance from the Totternhoe Stone to the coprolite bed is 70 feet, that being the thickness of the Chalk Marl, and above the Totternhoe Stone is the zone of *Holaster subglobosus*, at the base of the white chalk, of which the rest of the Lower Chalk, up to the Melbourn Rock, consists. At the upper end of the quarry was seen one of the springs which are thrown out from the base of the Totternhoe Stone, and it was sending forth a considerable volume of water.

After a few fossils had been obtained from the Totternhoe Stone, a field-path was taken past the Three Counties Asylum towards Hitchin, and from the highest ground reached the Director pointed out that the whole of the outcrop of the Cretaceous Series, from the Lower Greensand to the Upper Chalk, was in view; and Mr. Whitaker remarked that the outcrop of the Gault in this district was several miles in width, while in Surrey it was always less, and sometimes much less, than a mile wide, owing to the steeper dip of the beds in Surrey.

Passing over Wilbury Hill, the old encampment attracted attention just at the point where the Icknield Way crosses the high road at a right angle, and below the camp towards the west a few fossils were found in the Melbourn Rock, which here forms the summit of the Lower Chalk. There is only a small exposure.

After partaking of tea in Hitchin at the "Sun Inn," the fresh-water or lacustrine deposit at The Folly, Hitchin Hill, was visited. It is of Post-Glacial age, and contains, in its Palæolithic flint-implements, the earliest traces of man in the district. As this bed has been fully described by Mr. Clement Reid in our 'Transactions' (Vol. X, p. 14), where a list of the numerous fossils which have been obtained from it is given, it may here suffice merely to draw attention to the fact, not alluded to by Mr. Reid, that all the plants found in this deposit are either hygrophiles or water-plants, showing that the condition of the country was very different on the close of the Glacial epoch from what it is now, the soil and climate now favouring xerophiles. Some gravel-pits near by were also visited, drifted fossils and ice-borne rocks being found in them. They are of Glacial age.

The party dispersed at about 8 o'clock, some returning to Hitchin for the train and others cycling home. It was a glorious evening, and the three hours' ride to Watford was a very enjoyable one.

Field Meeting, 19th May, 1900.

ALDBURY.

A party of over twenty, the majority being ladies, assembled at Aldbury Church in the afternoon. Nearly all came, as usual, from Watford or St. Albans, mostly cycling, but a few driving from St. Albans, and two coming by train from Watford. The meeting was under the direction of Dr. T. E. Lones.

After inspecting the old tombs and monumental brasses in the Church, which is dedicated to St. John the Baptist and appears to date from about the middle of the fifteenth century, the old stocks and whipping-post by the side of the village pond were examined with much interest, for very few now remain.

Leaving the village, which is very prettily situated in a valley at the foot of the Chiltern Hills, the party walked up through the woods to the Monument erected on Moneybury Hill to the memory of the last Duke of Bridgewater in commemoration of the completion of the Grand Junction Canal. Most of the members having ascended it, the Director gave on the summit a brief description of the chief physical and geological features of the surrounding country, fairly well seen except for a great haziness which obscured the horizon. The low-lying Gault plain beyond Ivinghoe Beacon and Pitstone Hill was pointed out, and also the hills of less elevation which indicate the outcrop of the Lower Greensand at and near Leighton Buzzard, the hills of Ivinghoe and Pitstone being at the summit of an escarpment of which the Totternhoe Stone forms the principal ridge. The formation of the coombes or deep dry valleys at and near Aldbury was then referred to, and it was shown that they were mainly formed by the action of streams which formerly cut their way through the Middle and Lower Chalk, but have long since ceased to flow.

Proceeding down the avenue towards Ashridge House, the northern edge of Berkhamsted Common was reached, and a brick-yard on an "outlier" of the Eocene beds, capped by a thick bed of brickearth, was examined. This is one of the very small outliers which lie farthest away from the main mass of the Reading Beds and London Clay, and testify to the once great extent of these formations.

Descending the hill to Aldbury, tea was partaken of in the village, and the party dispersed.

Field Meeting, 29th May, 1900.

KEW GARDENS.

The members assembled at the principal entrance on Kew Green, and walked through the Gardens under the guidance of Mr. Daniel Hill.

The Tropical House was first visited, and here Mr. Hill pointed out the *Angiopteris* and *Marattias* as living representatives of an

extinct flora. The Succulent House was next visited, and then the large Greenhouse. Its many beautiful plants were in bloom, a great feature at Kew being the employment of autumn-sown hardy and half-hardy annuals for the decoration of this house in Spring, a practice which might, Mr. Hill thought, be copied in many smaller establishments. The house was gay with *Schizanthus* and the new decorative varieties of *Cineraria cruenta*.

Passing on into the Victoria Regia House, it was found that the plant was growing very vigorously but was not yet in bloom, and Mr. Hill said that he believed that it was not generally known that this huge water-lily was cultivated at Kew as an annual, the seed being sown every year.

Attention was next directed to the fine plant of *Lodiocea seychellensis*, the "Coco-de-mer" or double cocoa-nut, raised in the gardens some years ago from the nut of which the shell is still adhering to the plant. It is believed to be the only living plant in Europe, this palm being peculiar to the Seychelles Islands and only known in three of them.

After visiting the Orchid Houses the party walked through the Rock Garden, in the nooks and crannies of which many beautiful little plants were pointed out; and then, crossing the gardens, the Rhododendron Dell was entered, and was found to be in full beauty, presenting a magnificent spectacle. In the Azalea Garden the flowers were not fully out, but the blaze of almost every shade of colour, from white and yellow to red, was superb. The Bamboo Garden appeared to have suffered more than usual from the cutting Winter winds.

After visiting the Palm House, where a banana was seen in flower, tea was partaken of, after which the Temperate House and the "North" Gallery were visited, but it was just upon closing time for this, and the marvellous collection of paintings made by Miss North in all parts of the world, and most generously presented by her to Kew Gardens, could only be glanced through.

Field Meeting, 2nd June, 1900.

ST. ALBANS.

A walk of considerable archæological interest and a visit to the new County Museum brought together a rather small party at the place of meeting, St. Stephen's Church.

Mr. A. E. Gibbs acted as Director, and under his guidance the members walked by King Harry Lane to the Verulam Woods, where the path was taken which leads to St. Albans between the fosse and the south-eastern portion of the ruined wall of ancient Verulamium, and thence over the "Causeway," where it was left for the "Waterwalk," which follows the course of the Ver to St. Michael's Bridge. The narrow lane up the valley to Beech Bottom was then taken, and after inspecting this ancient British earthwork the members returned to St. Albans across Bernard's

Heath to visit the Museum. Here Mrs. A. E. Gibbs kindly provided tea for a party then much increased in number.

Several interesting questions were discussed in the course of the walk. King Harry Lane, it was mentioned, is sometimes called the Watling Street, and it would appear from the 6-inch Ordnance map that our Ordnance Surveyors considered this lane to follow its course, for they mark the farm-road between the end of the lane and "the Hollows" as its track, and bring it into the Gorhambury road at "Gorham Block." It was not so, however, for this is a winding country lane, not so very long ago merely a cart-track, and it is named from the much older "King Harry" public-house at its corner, opposite St. Stephen's Church. The British street continued in an almost straight line from St. Stephen's, and it may still be traced by the remains of a row of trees and of a hedge-bank across the fields to the kissing-gate at the lower end of the Verulam Woods, where it entered Verulamium and continued through the city past St. Michael's Vicarage and near the site of the Roman Theatre into the Gorhambury road, leaving this road at Gorham Block to cross the meadows below Mayne's Farm and join the Dunstable road between "the Pondyards" and Bow Bridge. Except for a short distance this road then follows its track to the ancient Durocobrivæ, near Dunstable.

On the same Ordnance map the Causeway is stated to be "on site of Aqueduct," but there seems to be no evidence that this very ancient dam, which confined the waters of the lake which protected the north-eastern boundary of the old British city, ever conveyed water *across* the valley of the Ver. On the same map, also, the reservoir in Præ Wood, which was constructed by Sir Nicholas Bacon to supply water to old Gorhambury House, is marked as a Roman camp, for which the site is a most unlikely one. The "deep lake" or fish-pool was purchased from King Edgar by Abbot Ælfric, and drained by cutting the dam near the present Silk Mills because the royal fishing-parties from Kingsbury Castle annoyed the monks. The Gorhambury reservoir was abandoned by Francis Bacon because the supply of water from it failed in very dry weather. He said that "as the water would not come to his house, he would take his house to the water," and built Verulam House by the Ver and there made his fish-pools, now known as the Pondyards. Not a trace of Kingsbury Castle nor of Verulam House now remains, but their fish-pools, or portions of them, still exist.

Beech Bottom, Mr. Gibbs said, on the arrival of the party there, was generally supposed to have been constructed by the ancient Britons, and was probably either a tribal boundary or part of a fortified post. It bore a general resemblance to the earthwork known as the Devil's Dyke, which formed the present boundary of the parishes of Sandridge and Wheathampstead, and to the still larger one, Grim's Dyke or Ditch, in the extreme west of the county. At the spot where they were then assembled Beech Bottom was of considerable depth and probably had not been much

interfered with, but elsewhere, owing to levelling by the plough and other agencies, it was not easily traced. It was stated by some authorities to enclose a considerable area, including the modern city of St. Albans, but it could not be traced around it satisfactorily. Running as it did in the same general direction—north-east and south-west—as the Devil's Dyke, which, as the crow flies, was only about two miles distant from it, he thought that it was quite possible for the two excavations to be part of one great earthwork extending from the Ver to the Lea. This was, however, pure conjecture, like all the other theories which had been started, for no one really knew anything about its origin or the purpose for which it had been constructed.*

This is the first time the Hertfordshire County Museum has been visited by the Society. Opened only so recently as the 15th of November, 1899, it is already, with the exception of the room set apart for a lecture-hall, full of objects of interest, chiefly local. Many local antiquities which were in private hands in St. Albans have been generously presented, and doubtless many more will follow. Once in the Museum they are secured for the city and county for ever, while otherwise they might be dispersed, as many have been, and by their severance from local associations lose more than half their value. That such objects have been thus secured is alone sufficient to justify the existence of the Museum. But its educational value is also great, and that is largely augmented by loan collections from the South Kensington Museum.

The Curators of the Museum are, for Natural History, Mr. Gibbs; for Geology, Mr. Hopkinson; for Archæology, Mr. William Page; and for Technology, Mr. A. Dean; and under their guidance the objects displayed in these various departments were examined.

A vote of thanks to Mr. and Mrs. Gibbs concluded the meeting.

Field Meeting, 16th June, 1900.

ROTHAMSTED, HARPENDEN.

The object of this meeting was to visit the Rothamsted Laboratory and experimental fields in order to gain some insight into the methods pursued and to learn something of the results attained. The meeting was under the direction of Mr. W. R. Carter, who conducted a cycling party from Watford and through St. Albans, where others joined, to Rothamsted, and there transferred his responsibility to Mr. J. J. Willis, who first showed the members over the laboratory and then conducted them through the park and experimental fields.

Only a few points touched upon by Mr. Willis can here be mentioned. He said that all plants from the tiny moss to the large spreading oak require the element nitrogen as food, and that it was formerly thought that plants took this nitrogen through their

* For other remarks on Beech Bottom by Mr. Gibbs see 'Transactions,' Vol. IV, p. xx (1887).

leaves from the atmosphere, but that it has now been ascertained that it is only their roots which absorb it, showing the great importance of a supply of nitrogenous plant-food in the soil. The difference between cropped and uncropped soil in relation to their water-holding power was pointed out, and also the difference between plants supplied with and without nitrogenous manure.

Mr. Willis then showed how leguminous plants grown in rotation increased the fertility of the soil, but if grown year after year impoverished it. In Hoos Field red clover was sown twelve times in 29 years, and failed eight times out of the last ten trials. Thus, when sown frequently on the same land there was almost uniform failure, practically no crop being obtained after the first few years. In 1878 various leguminous plants of different habits of growth, and different character and range of roots, were sown on clover-exhausted land. Red clover still failed, but the weakly-rooted white clover, which had not been sown on the land for many years, did well, and the deeper-rooted vetch better still, while the very strong and deeply-rooted lucern did remarkably well. The general result of these experiments was to show that when various leguminous plants were sown where red clover had failed, they grew luxuriantly and absorbed larger, and in some cases very large, amounts of nitrogen. The more clover, also, that can be got to grow, the bigger will the succeeding wheat-crop be; but wheat was seen to be growing best of all after lucern, the roots of which go down ten feet from the surface and bring a great amount of nitrogen from the subsoil into the surface-soil. Not being exhausted by the crop of lucern, it is thus brought within the range of assimilation of the roots of the wheat.

With regard to permanent meadow-land, Mr. Willis stated that the better the pasture the more can the grasses be forced, but that if too much manure be put on, the coarser qualities of grass are encouraged and the finer grasses and clovers die out. This is evidently the result of a struggle for existence, the coarser grasses having greater assimilative powers than the finer, and the latter being crushed out the general crop loses in nutritive value.

Some results of experiments with Swedish turnips were mentioned, and diagrams illustrating them were shown in the laboratory. On unmanured land the yield was $8\frac{1}{4}$ cwt. per annum per acre, with mineral manure 11 tons $6\frac{1}{4}$ cwt., and with both mineral and nitrogenous manure 24 tons 18 cwt., showing the great value of a supply of nitrogen.

The rain-gauges and percolation-gauges were also examined, and Mr. Willis stated that the large rain-gauge, which has an area of one-thousandth of an acre, collects from impurities (smoke, etc.) in the air 5 lbs. of nitrogen per annum. There are two other rain-gauges, one with a receiving area 5 inches in diameter and the other 8 inches. The three percolation-gauges are of the same area as the large rain-gauge, and they have a depth of soil of 20 inches, 40 inches, and 60 inches. The surface of the soil is kept quite free from vegetation, their chief purpose being to show

the loss of nitrogen from the soil in drainage. From the absence of vegetation the amount of water percolating through them is greatly in excess of anything which occurs with soil in its natural condition, and the loss of plant-food is more considerable. Their results are calculated for what is called the "harvest-year" (September 1 to August 31).

In reply to a question, Mr. Willis pointed out that the pea and the sainfoin differ in their habits of growth, the pea being an annual and the sainfoin a perennial. Leguminous plants, which have to continue their existence for more than one year, possess the power of storing up in the nodules, which are formed on their roots, plant-food for subsequent years. It may be mentioned that the sainfoin was formerly called "St. Foine."

The meeting, which proved a most interesting one, concluded with a walk through Rothamsted Park and tea at Harpenden.

Field Meeting, 30th June, 1900.

RUISLIP RESERVOIR.

The last of the field meetings of this Summer was devoted to a visit to Ruislip Reservoir, for the first time in the annals of the Society. Nearly all the members cycled from Watford, under the direction of Mr. Hopkinson, proceeding along Hamper Mill Lane, by Oxhey Woods, and through Frith Wood to Northwood Station, where it had been arranged to meet those who came by train.

From Northwood a field-path was taken to the Reservoir, and near its foot, just before leaving Ruislip Common, the Director gave a brief summary of the geological changes which have occurred in the district since Silurian times, tracing in succession the upheaval in South Herts and North Middlesex of the Silurian and Devonian rocks; the deposition during long ages of beds of which not a trace remains in this district, which may have been a land-area all this time; the deposition of the Cretaceous rocks; the origin, upheaval, and denudation of their highest member, the Chalk; and the deposition, upheaval, and denudation of the Tertiaries. The advance of the great Scandinavian ice-sheet as far south as the range of hills which had been crossed between Watford and Northwood was then described, with its subsequent retreat and the elevation of the land, again to subside to pretty near its present level about the time when the Straits of Dover were formed, permanently separating England from the Continent of Europe. And finally, the foldings of the strata were described, or rather, perhaps it should be said, the slight deflections in the dip due to lateral pressure or shrinkage, which it was shown had probably given rise to the lines of outliers of the Tertiaries on the Chalk, and of inliers, showing the Reading Beds and sometimes the Chalk exposed beneath the London Clay, one such inlier of the Reading Beds, surrounded by the London Clay, extending from Pinner to the spot on which they were now standing.

The Reservoir is a feeder of the Grand Junction Canal, the stream whose waters have been impounded being a tributary of the Colne. Its surface where the water is shallow was pink and white with the flowers of the water-plantain (*Alisma plantago*) and the water-crowfoot (*Ranunculus peltatus*).

After having tea in a cottage-garden, the cyclists returned to Watford by Batchworth Heath and Rickmansworth, the walking party going to Pinner Station. Between Moor Park and Watford the somewhat rare and very handsome *Campanula latifolia* was detected in a new locality by Mrs. Hopkinson, who had also discovered it in a new locality near St. Albans some years ago, as recorded in Pryor's 'Flora.' It was not easy of access, and it was resolved not to divulge its situation, but a flowering spike was gathered by Miss Rumboll for the herbarium of the Hertfordshire County Museum.

NOVEMBER.] Price 1s. [1898.

TRANSACTIONS

OF THE

HERTFORDSHIRE NATURAL HISTORY SOCIETY

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VOL. X. PART 1.

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HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB.

The objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, Ethnology, Pre-Norman Archæology, and Topography of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Physics and Biology. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

Evening meetings of the Society are held at the Watford Endowed Schools at least once a month during the Winter and Spring. Evening meetings are also held occasionally at St. Albans, Hertford, and other places. Field meetings are held during the Spring and Summer in various parts of the County.

Members pay an Entrance Fee of 10*s*., and an Annual Subscription of 10*s*., for which they may, if preferred, compound by a payment of £5. Ladies are eligible for election.

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TRANSACTIONS

OF THE

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I.

ADDRESS.

CHALK WATER IN HERTFORDSHIRE.

By the President, William Whitaker, B.A., F.R.S., Pres.G.S., Assoc. Inst. C.E.

Delivered at the Anniversary Meeting, 22nd February, 1898.

Ladies and Gentlemen,—

In searching for a subject for the Address, which by an absurd custom a President is expected to inflict on his suffering Society, I have come, by a process of natural selection, to that of Chalk water; and this not merely because it may be of interest to members of the Society, but more because it comes easier to me than any other just now. It should be clearly understood, however, that no attempt will be made to treat the matter systematically, a proceeding that would need a book, and I am not by nature a bookmaker of any sort. You will merely have sundry notes and discursive remarks put before you, avoiding as a rule contentious matter, so far as is possible indeed with a subject the mere mention of which is enough to put some of our members into their most aggressive and disputatious spirit.

I purpose to take you on a ramble by some of our springs and swallow-holes. When we have thus seen something of water at the surface, we may give some thought to underground water, glancing at its variation in level, and considering the varying composition of its mineral contents. My remarks will be restricted to things that I have seen, and to matters that I have had to consider, of late years.

Springs.

The celebrated Chadwell Spring is close to the southern edge of the marsh of the Lea, about two thirds of a mile south-west of St. Mary's Church, Ware, and its waters are taken for the supply of the New River Company. Reference was made to this spring before the Royal Commission on Metropolitan Water Supply (1892), Mr. J. Francis, Engineer to the New River Company, saying that he had made careful observations to find whether the pumping at any of the Company's wells "has any effect upon the spring, and it has none whatever. Broadmead well is within a quarter of a mile of the spring, but there is no communication whatever between the two." Mr. Topley adds that, "Knowing the large amount of pumping and seeing the position of the wells in relation to that spring, I should certainly have expected that the Chadwell spring would cease to run altogether. . . . It is a very extraordinary thing with the large amount of pumping within such a short distance that that spring should still continue to run." *

It should be remembered that, besides the Broadmead well, there is also the Amwell End well, less than three quarters of a mile from the spring, and the Amwell Hill well, about a mile and a quarter off, all being lower down the valley than the spring, as also are the Ware Waterworks.

At the time when this evidence was given I had not seen the Chadwell Spring for many years, and shared Mr. Topley's surprise that it had not been affected by the long-continued pumping.† It was not until just as the work of the Royal Commission was closed and later that I had the chance, on two occasions, of again seeing this spring, which of course was then examined more carefully than it had been long before, at a time when I was thinking only of the mapping of the geology of the district and not of springs or of underground water. The result of this examination was to deprive me of any wonderment that the spring had not been affected by the pumping, and to lead me to be prepared rather to wonder if it should be affected, at least unless the amount of pumping were greatly increased.

Let us examine the condition of things at Chadwell. The spring is just on the Alluvium or marshland of the Lea. The inverted cone which has been formed in a way usual with Chalk springs is evidently deep, for when the water is clear, no one standing on the

* 'Minutes of Evidence,' pp. 197, 317 (1893).

† This is a disputed point. Evidence to the contrary may possibly be brought before the Society.—Ed.

margin can see the bottom at the central part, and on inquiring of Mr. Francis he kindly tells me that "the greatest depth that can be felt by means of a pole is about 18 feet below the water-surface. From this depth the fissures seem to extend downwards at a considerable angle with the vertical."

We have no reason to expect any great thickness of Alluvium in this part of the valley of the Lea; but, on the other hand, we have every reason to expect a very slight thickness close to the edge, as at this site, and it would follow therefore that the greater part of the depth to the Chalk at the spring is taken up by the gravel which underlies the Alluvium throughout. This gravel is highly permeable, perhaps one of the most permeable deposits that we have: it is saturated with water along the whole channel, and is most likely in communication with the river at many places. It seems to me therefore that to dry the Chadwell Spring implies drying the Lea.

(The above remarks are left as written, with a slight verbal correction. They show the danger of being too sure in such cases, for the Chadwell Spring has since failed so far as water-supply is concerned, though the Lea has not ceased to flow.)

That there have been great fluctuations in the yield of the spring is certain, as may be seen from tables of gauging, brought before the aforesaid Commission by Mr. Francis, which show that the average daily discharge in weekly periods, from January, 1889, to March, 1892, has varied from 4,698,000 gallons in March of the former year, down to less than a tenth of that amount (450,000 gallons) in September and October of 1891. The yield reverted again to very nearly the former figure (4,644,000) in March, 1892, and the figures show many fluctuations. These differences are explained as due to seasonal variations.

It should be remembered that the spring is simply the overflow of water from the Chalk, forced up through the gravel, etc., and that its discharge is a natural one, unaided by pumping. When the spring lessens in volume so also does the water in the river.

Chadwell Spring has another peculiarity, in that its water becomes very cloudy soon after a considerable amount of rainfall. On the last occasion that I saw it one could not see anything eighteen inches below the surface, whereas generally in Chalk springs one can see several feet down, indeed to the bottom in any but the deepest springs.

I believe that it has been suggested that this cloudiness is due to the muddy water, from the clay-slopes, that finds its way into the swallow-holes near North Mimms, which has been thought to flow

in this direction. This is a very pretty theory, on the whole too pretty for a matter-of-fact Englishman, for it involves either an absence of filtering power in a great length of the Chalk, or a direct and fairly open channel through the Chalk for a distance of some nine or ten miles, and a speed of flow, down a by-no-means rapid incline, which does not allow of the subsidence of the suspended particles.

It seems to me that a simpler reason can be given, and it is the true scientific method to take simple explanations rather than elaborately ingenious ones. The casual observer likes to adopt grand views, and often does not like to have these put aside for very commonplace ones. I trust that I may not be treading on anyone's pet mental corn in suggesting that the fact of the Chalk hill directly above the Chadwell Spring having a capping of gravel, is enough to account for the cloudiness of the water after heavy rain. Possibly, too, the communication with surface-water, by means of the gravel under the marsh, above alluded to, may help towards this undesirable result.

Another spring in a like position to that of Chadwell also has its water clouded soon after rain, as Mr. Urban Smith, with whom I saw it, tells me. This is Arkley Hole, in Spring Wood, at the eastern edge of Woolmer's Park, in the parish of Hertingfordbury, close to and on the northern side of the River Lea, the surface of the water of which is, I believe, about 6 feet below that of the spring. Here again the Chalk is capped by Drift, and the cloudiness can thus be accounted for.

At Hoddesdon (again on the information of Mr. U. Smith) the water of the Lynch Spring, on the eastern side of the New River, clouds after rain. But in this case there is a still more apparent explanation, as the Woollens Brook, which receives the drainage of a small tract of Drift and London Clay north-westward of the town, passes by the springs.

I believe that Mr. R. W. Mylne was the first to suggest that the Chadwell Spring derives its water, or part of it, from the Mimms swallow-holes, in evidence given in 1867, and it may be well to reprint part of his remarks on some of our Hertfordshire springs, especially as they are in a Blue Book, and therefore practically hidden from nearly all our members.* "As respects the springs between Amwell and Rye House, they vary in volume and are affected in colour in wet weather." Here again there is plenty of Drift above the springs. Their origin he thinks "it is not

* Royal Commission on Water Supply. 'Minutes of Evidence,' pp. 281, 282. Fol. London, 1869.

improbable may be attributed to a local change in the dip of the chalk, consisting of a gradual depression along the escarpment of the tertiaries . . . from Hatfield . . . to Rye House . . . at an inclination of about 20 feet per mile, the line of which is nearly at right angles to the general dip of the Chalk." It is to be noted, however, that such a fall in the level of the boundary-line between the Chalk and the Tertiary beds, which I presume is what is alluded to, does not always imply a local change in the dip, but may be owing rather to the cutting back of the beds somewhat down the plane of the ordinary dip.

Then he goes on to say: "There is, however, another feature lying beyond the watershed drainage area of the Lea which there can be little doubt has an important bearing on the source of these springs, viz., the existence of an isolated clay catchment basin of 23 square miles, which has no direct surface outfall, the central and lowest part of which is between North and South Mims where the surface is chalk, and several swallow-holes exist in the locality which receive and absorb the drainage water of the district. The natural tendency in this case would be for the waters to flow in the direction of the general dip of the chalk basin, but from the inclination of the strata towards the east, there can be no doubt a considerable portion of the water is carried off in that direction. There is a small ridge at North Mims separating this catchment basin from the Colne valley, the entire volume of the drainage shoots down from off the clay lands on to the chalk, and pours into numerous swallow-holes and entirely disappears."

The above remarks refer only to a probable origin of springs between Ware and Hoddesdon, but further on the following words occur: "The source of the Chadwell spring, though deep seated, may possibly be influenced from the same circumstances."

Let it be understood that whilst questioning the explanation of the clouding of the spring-waters from the suspended matter taken into the Chalk by water at the surface 9 or 10 miles off, I do not dispute the northerly underground flow of much of the water that sinks into the Mimms swallow-holes. That it goes so far eastward as Chadwell and Amwell is, I think, open to doubt.

Swallow-holes.

These remarks naturally lead to the subject of swallow-holes, and it is perhaps well to explain here that these are hollows into which small streams disappear.

They are usually found close to the junction of the Tertiary beds and the Chalk, the water flowing down the clay-slopes and sinking

into the permeable chalk, sometimes down a sort of funnel, sometimes in a wee pool. In places, however, they occur in series along valleys in the Chalk, a little below the Tertiary beds, as is the case in the neighbourhood of North and South Mimms. In such a tract the stream sometimes disappears low down its course: as the season gets drier the point of disappearance gradually ascends, and the lower swallow-holes are left dry, the reverse of course taking place as the water increases.

This subject is well illustrated in our county, and is by no means an unexplored one, for our swallow-holes have been noticed by many observers. Mr. Hopkinson and the Rev. J. C. Clutterbuck have specially discoursed to you on some of them, and I must plead guilty to having noticed them on various occasions in the course of my work, in Geological Survey Memoirs.

When contributing a Memorandum on the subject to the Royal Commission on Metropolitan Water Supply* I thought that I had done with it, for some time at least; but in the summer of 1893, when it was too late to incorporate fresh notes in my paper, I had the advantage of making a pretty thorough examination of the Mimms swallow-holes, with Mr. T. H. Martin, Engineer to the Barnet District Water Company. As there had been a long spell of dry weather the stream-course was dry for a long way, and the swallow-holes could be seen and examined in a manner that is not possible when they are in action. My notes, therefore, may be acceptable, at all events as a low-water record.

The swallow-holes on the Catherine Bourne, about two thirds of a mile north of Ridge, one of which (close to the county-boundary) is rather lower than the neighbouring stream, were dry. The valley of the Mimmshall Brook contains many swallow-holes. Down this stream we will now go. On May 2 there was water along Watery Lane, that part of the channel which serves the double purpose of a roadway and of a water-course, for about a quarter of a mile above Bridgefoot; but on June 9 this was dry. At the latter date there was a little water in the lower pond at Bridgefoot. Below this the stream-course was dry, except for mere pools of water in places.

About a third of a mile below Bridgefoot one could see, at the foot of the bank, many flint-pebbles and some brown loam, these being suggestive of the basement-bed of the London Clay; whilst a little south of west from Mimms Hall pebbles and green-coated flints were seen, suggesting the junction of the Reading Beds with the Chalk.

* 'Appendices to Minutes of Evidence,' pp. 430–438. Fol. London, 1893.

At some places small hollows were seen in or at the side of the channel, which are probably swallow-holes, and a quarter of a mile north of Mimms Hall was a pool, where the stream from Potter's Bar joins.

The chief swallow-hole, or rather set of swallow-holes, in this upper part of the valley, is a third of a mile north of Mimms Hall, where there is a sharp bend in the stream-channel, so that a little cliff has been cut on the eastern side. Here the water was sinking in slowly at various spots on May 2, but on June 9 the place was dry. Under ordinary circumstances a great deal of water must find its way into the Chalk here.

Half a mile north of Mimms Hall there was a pool in June; but before getting to this several holes were seen in the channel.

After crossing the county-boundary at Warren Gate, nearly three quarters of a mile below Mimms Hall, the channel was found to be grassed for a little way, and then, rather more than half-way from Warren Gate to Abdale House, there is a well-marked swallow-hole, which, being a little way east of the channel, acts only when the stream overflows. It is to be noted that on the six-inch Ordnance Map (Herts, Sheet 40) this part is called Water End, as well as the hamlet just north, to which probably the name should be confined.

At the true Water End, as I take it, some of the swallow-holes are definitely marked on the Ordnance Map, but there are many others: indeed, the open tract between Water End and Potterell's Park seems to have been specially set aside for the manufacture of swallow-holes, the ground being pitted by them, and several being well-marked funnels down into the Chalk. These were dry on June 9, 1893; though at one place, just south of the footpath a little N.N.E. of the Old Maypole, I saw some liquid, which, however, was not water but sewage, not exactly an advantageous addition to underground water.

Below this I have seen no swallow-holes, and did not follow much of the dry channel, but my former colleague, Mr. A. G. Cameron, has noted that on November 1, 1891, there was no water northward of North Mimms Church, and on a visit with him in July, 1896, the stream seemed to start where the channel crosses the parish-boundary at Colney Heath.

Turning now to side-streams on the right bank, in that from Potter's Bar I found in May, 1896, three wee hollows, which may be sink-holes, just above the narrow marsh north-east of Warrengate Farm, whilst just southward, along the hedge across the marsh to

the stream, are three small sink-holes, which were dry, and presumably only act when the marsh is flooded.

In the next valley to the north, swallow-holes are marked on the Ordnance Map (Herts, Sheet 40) in Gobions Wood, north-westward of Littleheath. These were all dry on June 9, 1893. The lowest marked is a large hollow, and in the highest marked, where a foot-path crosses the channel north of Bolton's Farm, I saw chalk at the bottom. These swallow-holes show an error in the Geological Survey Map (Sheet 7), presumably from an uprise of the beds which escaped note when the surveyor (the late Mr. Trench) was working on the old and not too exact one-inch map. This uprise may perhaps be connected with that which brings up the Chalk inlier at Northaw, on the E.S.E. Such an uprise might have some effect in hindering the passage of water underground in the Chalk from the upper swallow-holes of the Mimms Hall Brook north-eastward.

We come lastly to the stream from Marsh Moor and Welham Green, which passes through the northern part of Potterell's Park, receiving the sewage of the house some little way above the highest swallow-hole marked on the Ordnance Map (Herts, Sheet 35). A little further down, westward of the house, there was water for a short way on June 9, 1893, and the second marked swallow-hole was in action. There are others below, as the stream debouches on to the great swallow-hole tract above noticed.

Underground Water-level.

The long series of swallow-holes in the Mimms valley, and their intermittent action, show that the level of the underground water varies. When this rises to the surface everywhere along the bottom of the valley there is a continuous stream; when it is lower the stream ends in successive swallow-holes, according to that lowering, and also reappears at successive points northward. There must therefore be an inclination of the underground water-level down the valley.

Such inclinations, or water-slopes, occur nearly everywhere in the Chalk, though nature rarely gives us proof of them, only indeed in the case of bournes, or intermittent streams, that is to say, only along the bottoms of some valleys. But by means of wells and borings we are able to get some notion of the water-slopes away from the valley-bottoms.

As a general rule in a Chalk district it is found that such water-slopes show a rough parallelism with the contour of the ground above, that is to say, that as the ground rises the underground

water-level rises too, though to a much less extent. This is what we should naturally expect: but it is sometimes found that the summit of the water-slope is not under the summit of the ground-slope, the water-hill and the ground-hill being by no means in the same vertical plane; sometimes, indeed, the water-slope revolts, asserts its independence, and seems not to be governed by the ground-slope.

A case of this sort in Hertfordshire having come under my notice, I was somewhat troubled thereby, and cast about to find an explanation. Perhaps I have not succeeded, but if I have it does not follow that the explanation which has occurred to me as possible for the Hertfordshire case is to be accepted in all such cases: at different places there may be, and often are, different conditions, and it occurs to me that a like case, in another county, cannot be explained in the same way as that about to be suggested.

But, firstly, let us have the facts, for which I rely on the good authority of our County Surveyor. In the course of his official work, Mr. Urban Smith had to undertake some investigations on underground water-levels, for a case in which I had the pleasure of working with him, and he has kindly allowed me to put before you some of the general results; the details would be out of place here, and, moreover, are not ripe for publication.

In a section plotted across the valleys of the Rib and the Lea, from north-west to south-east, the following figures came out, and in all cases they refer to feet above Ordnance Datum, or mean sea-level, at the various wells or streams:—

	N.W.		River Rib.					S.E. River Lea.	By Chadwell Spring.	
Ground-level	275	165	138	233	244	222	194	110	152	227
Water-level.....	167	141	138	128	128	113	112	110	108	107

The gradient of the water is 26 feet in a mile from the first well observed to the Rib, and beyond to the next well; then 9 feet to the next, a little way off; then 29 feet to the next; 12 to the next, a little way; and then 11 to below the Lea.

It will be seen that there is a steady fall in the water-level south-eastward, without any rise under the higher ground between the Rib and the Lea, a distance of about a mile and a half.

A section across the Lea at Ware, from north to south, shows a fall of the water-level from near Thundridge to the river, at the rate of 30 feet to a mile (150 to 99); but the old Ware Waterworks level,

whilst pumping, was only 85 feet in April, 1896, or 14 feet below the river, illustrating the marked effect of pumping, which, however, apparently did not reach very far, as, at the same date, the rest-level at the new Waterworks, about a quarter of a mile southward of the old works, and more than that distance from the river, was over 106 feet. On the south the average fall to the river is at the rate of 19 feet a mile.

Now, turning back to the first of these sections, what is the state of affairs? In a tract of bare Chalk, or of Chalk but thinly covered with surface-beds—in other words, in one where rain has a tolerably free access to the Chalk—the underground water falls gradually from the higher ground to the lower, as a general rule at all events; but here this is not the case, the water-slope throughout falling south-eastwards, and paying little regard to the rise of the ground between the two rivers.

On looking at a geological map on which the Drift is shown (and no other is of the slightest use in this case) we find that bare Chalk occurs only at the basal part of the valley-slopes, the whole of the rising ground between these narrow outcrops being composed of Drift, which is of fair thickness and largely composed of clayey material. It follows therefore that the rain is greatly hindered from getting into the Chalk over this higher ground, and so there is little local addition to the water in the Chalk, and no cause for local rise in the water-level. Moreover, from the thickness of the Drift the Chalk cannot rise much in level under the hill.

It seems to me that the widespread capping of fairly thick Drift makes the circumstances different from those of an ordinary Chalk tract with much less Drift. In the present case the water-slope in the Chalk is left with little interference from above, hardly any water coming in that way, so that this water-slope very nearly follows the general dip of the beds or the general slope of the ground, both more or less from north-west to south-east, as perhaps also is the general direction of the main fissures or joint-planes in the Chalk, which are mostly the chief water-carriers.

This explanation is given only as the best that occurs to me, without any dogmatic assertion of its correctness, and in readiness to accept a better should someone find it.

I am not going into the controversial question of whether our yield of water is decreasing or not. Every Englishman has an inborn right to complain that things are worse than they were formerly, that is to say, the things that specially affect him; other

things have usually improved. But it is interesting to note that complaints as to the decrease in the flow of streams are no new matters.

In the course of my somewhat miscellaneous reading, I have come across a note of some remarks in 'The Chronicle of Roger of Wendover,' to the following purport:—The same year (1178) there was a certain man who lived at his native town, St. Albans. This man was summoned by a glorious visitant to rise and follow him, and they went to Redburn. To which a footnote, by Matthew Paris, adds that on the way they conversed with one another, as is the custom amongst friends travelling together, at one time of the walls of the ruined city, at another of the decrease of the river.

Since this very early record of a meeting or excursion of our Society (for the description of the conversation clearly points to this) we seem to have improved, by the addition of various other subjects of conversation amongst our members, and by having somewhat larger meetings; but on the other hand we have fallen off lamentably in the utter disappearance of the glorious visitant.

Chemistry of Chalk Waters.

Let us now pass on to consider some facts regarding the mineral contents of Chalk water. I allude to the marked difference shown by chemical analyses between waters from wells in places where the Chalk is bare or but very slightly covered by other beds, and waters from wells in places away from the outcrop of the Chalk and where that rock has not been reached until after a considerable depth of Tertiary beds has been pierced through.

A large number of analyses by many chemists show that the waters of the open Chalk have a less amount of "total solid contents" than those of the covered Chalk. They also show that not only is there this difference in quantity, but also an equally marked one in character: in the former waters the salts of lime, and chiefly the carbonate, are the main constituents; in the latter waters we get a much greater amount of salts of sodium, and also of potassium and magnesium. There is, too, an increase in chlorides and sulphates.

The deep-seated Chalk waters, indeed, often give an analysis more like that of a sand water, and sometimes chemists have been misled by this to describe these waters as from the Greensand, the mistake being perhaps the more readily made from some of the Tertiary sand passed through in the wells or borings being greenish, especially when moist.

We have an example of this change of composition in the mineral matters of Chalk water just beyond our county, from which county, however, the water is derived, for Mr. J. Francis writes to me, concerning the wells of the New River Company, that "analyses show that in the case of those of our wells that are nearer London and under a considerable depth of the Tertiaries, the water is certainly more alkaline than in those of the open Chalk."

Some ten years ago the subject came before me in the preparation of a Geological Survey Memoir, and I tried to account for it. The only explanation which I could give, and somewhat doubtfully, was that through communication between the Chalk and the overlying Tertiary sands some of the salts in the latter had been dissolved out into the water. I am still inclined to think that this idea is not wholly without foundation; but doubt whether it is enough to account for the facts.

Soon after the publication of my Memoir I became aware of a paper published two years earlier, wherein a better explanation is given, and to this paper your attention will now be drawn. It was written by one of the distinguished chemists who have worked in the Rothamsted Laboratory, and who still dwells in the county.* Although this paper is now more than ten years old, I fear that others may be ignorant of it, as I was for a time, and, indeed, I have found that few geologists or engineers know of it; one may, therefore, quote from it with all the more reason.

After an elaborate investigation of the well-waters of Harpenden, Mr. Warington compares his results with those from other wells, and he finds that the minimum of chlorine in the water of the Harpenden wells is rarely reached in 111 other analyses. As many of these were of high-class waters, he says "it would appear that there is some peculiarity in the chalk water of Harpenden so far as its contents in chlorides is concerned. I venture to think that the low proportion of chlorides in the pure well waters of Harpenden may be due to the situation of the village not far from the escarpment of the chalk at the northern edge of the Thames basin. The chalk here being at a considerable elevation . . . . and the gradient of the underground water level very considerable, the chalk rock has been in the course of ages washed very thoroughly by the percolation of rain, and the chlorides originally present in the rock when upheaved from the sea have been almost completely removed. The wells of the lower part of the chalk basin are

* "A Contribution to the Study of Well Waters," by R. Warington, F.R.S.: 'Journ. Chem. Soc.,' vol. li (1887), p. 500.

obviously supplied to a considerable extent by the underground drainage from the upper part of the basin. This underground drainage water when it passes Harpenden contains about 11 of chlorine per million of water; but as it continues to percolate through masses of chalk at a great distance from the surface, it may be assumed to gain chlorides from the small residue of common salt remaining in the rock; so that wells in the lower part of the basin should, on an average, contain water richer in chlorides than wells at the edge of the basin."

He then speaks as follows of the water in the Chalk obtained from wells in the London Clay district:—"The clay has of course prevented any percolation of rain from above; the washing of this chalk has therefore for many ages been confined to the slow passage through it of water from the upper part of the basin, already containing chlorides." In consequence of this, water in wells far from the sea shows a richness in chlorides.

It seems to me that the above is a good explanation, and the more so as it accounts for like occurrences (sometimes of a stronger kind) in other formations than the Chalk. The washing out of the salts from the Chalk from the escarpment downward to the central parts of the basin, where concentration would take place; the possible addition there of salts derived from the Tertiary sands (between the London Clay and the Chalk); and perhaps some chemical changes slowly brought about in the deep-seated water: these would seem to be enough to account for the great differences in the mineral contents of the waters in the open and in the covered Chalk.

Mr. Warington deserves our thanks for his work, both from its showing the interdependence of branches of science and from its being an important addition to the scientific knowledge of our county.

In conclusion, let me say that my remarks are meant to be suggestive, not dogmatic. We have yet much to learn on the subject of Chalk water, and it is to be learnt, not by work in one groove only, geologic or otherwise, but by joint work in various divisions of science. It is pre-eminently a subject for a Society such as ours, being general in scope but needing local treatment. We have already published some papers on the subject, and if this Address leads to further records being undertaken and brought before us, it will not have been useless.

II.

THE PALÆOLITHIC DEPOSITS AT HITCHIN AND THEIR RELATION TO THE GLACIAL EPOCH.

By Clement Reid, F.L.S., F.G.S.

(Communicated by the President.)

Read at Watford, 22nd March, 1898.*

Certain excavations and borings at Hoxne, undertaken in the year 1896 at the cost of the British Association and of the Royal Society, threw much light on the relation of Palæolithic man to the Glacial Epoch. It was thought advisable therefore to examine the similar deposits at Hitchin, to ascertain to what extent the conclusions already arrived at were supported by exploration at a fresh locality. It was desired also to see whether a new locality would aid us in restoring pages in the geological history missing in the Hoxne record. At the instance of Sir Archibald Geikie, a grant of £50 was made by the Council of the Royal Society towards the cost of the necessary excavations, borings, and incidental expenses, unavoidable if the inquiry was to be carried out satisfactorily. Of this sum, only about £30 has been expended, for, after reaching a certain stage with good results, it was discovered that any further advance meant a far greater expenditure of time and money than seemed justified. Work was therefore stopped as soon as the main point under dispute had been cleared up and a sufficient series of fossil plants had been obtained to determine the climatic conditions which held while the ancient alluvial strata were being deposited.

It is perhaps scarcely necessary under the circumstances to do more than allude to the results of previous work. Palæolithic implements have long been known from Hitchin, and their position in and at the base of a stony brickearth was well ascertained. It was also known that this brickearth rested on loam and shell marl, with fresh-water mollusca and mammalian remains. All this had been made perfectly clear, principally by the researches of Sir Joseph Prestwich, Sir John Evans, Mr. William Ransom, and Mr. William Hill. The most important of the doubtful points were the relations of these ancient alluvia to the widespread sheet of Chalky Boulder Clay, and to the valleys of the existing streams.

In the prosecution of these supplementary researches I have been greatly aided by the local assistance freely rendered by Mr. W. Hill and Mr. W. Ransom. I have also to thank the different landowners and tenants, especially Mr. Theodore Ransom and Mr. Jeeves, for the liberality with which they have permitted excavations and borings to be made on their land.

* Reprinted from the 'Proceedings of the Royal Society,' vol. lxi (1897), p. 40, by permission of the Council.

A preliminary examination of the neighbourhood of Hitchin convinced me that the Palæolithic and ancient alluvial deposits there found occupied a small irregular valley, which had become silted up and almost obliterated. It was desirable to construct an accurate geological section across this valley, such as we were able to draw at Hoxne; but it seemed likely that conditions would prove much less favourable than at Hoxne, and that the coarse, loose, and watery character of the strata would render work difficult. Such proved to be the case, and instead of being able to make a connected chain of borings, it was necessary to select sites where the difficulties could best be avoided. The result of this method of work has been, that while the general structure and relation of the deposit have become perfectly clear, it is impossible to draw an accurate section across the old valley. Bore after bore was stopped by the closing-in of the sides or by the gravelly nature of the beds, and though no doubt with time and money the deposits could have been pierced, previous experience did not encourage me to persevere, or to hope for any very definite results even if the bottom of the old channel were reached. Attention was therefore mainly devoted to the search for Boulder Clay beneath the Palæolithic loams, and to the sinking of a trial pit and bore at the point where the buried valley appeared to be deepest.

This exploration tended to show that the story told by the old valley at Hoxne was repeated at Hitchin. Indeed, the succession of events at the two localities was so similar as to leave scarcely a doubt that we were dealing with an equivalent set of strata, though unfortunately the series was less perfect, and the gaps discovered at Hoxne are still unbridged by any records yet found at Hitchin. Hitchin yields strong corroborative evidence in favour of the conclusions arrived at in the Hoxne Report, and adds somewhat to our knowledge of the temperate flora of the ancient alluvial strata lying between the chalky Boulder Clay and the Palæolithic brickearth. I must confess, however, that in other respects the results are somewhat disappointing.

Hitchin lies in the valley cut by the Hiz, a small stream which rises within a mile of the town. Chalk is seen in the valleys, and rises irregularly through the thick sheet of drift which masks most of the area. The greater part of this drift consists of coarse flint gravel, partly of Glacial, partly of Palæolithic age, and one of the greatest difficulties met with is the impossibility of deciding whether any particular pit is in Glacial or in Post-Glacial gravel, and whether the gravel passes under or over the chalky Boulder Clay. The material being used again and again, the composition of the gravel is practically the same in each case, except for the occurrence of implements in the newer deposits. It was soon found that Mr. Hill was right as to the difficulty of obtaining satisfactory evidence from a study of the gravels. Even between clear sections correlation is impossible, and boring in boulder gravels is so difficult and expensive that I did not feel justified

in spending money in attempting to penetrate them to the Boulder Clay. Even if the Boulder Clay were reached, it would be fairly open to any critic to say that nothing had been settled, as there is no evidence which of some three or four gravels may be the one represented at that particular spot.

The first thing to be done evidently was to ascertain whether the chalky Boulder Clay, an undoubted Glacial deposit, passes under or over the Palæolithic brickearth. With this object, borings were made in the pits out of which implements have been dug. The details of the borings are given in the Appendix; the results may be shortly summarized thus:—In Ransom's (New) Brickyard, after penetrating the Palæolithic brickearth and underlying fluviatile loam to a depth of 60 feet, some blue, chalky clay was penetrated in bore-hole 2, and in bore-hole 1 derivative fossils from the Boulder Clay were obtained at about the same level in the lower part of the old alluvium. In each case boring was stopped by gravelly sand full of water. Other borings in Jeeves' Yard and in some old brick-pits on Maydencroft Farm yielded no trace of boulder clay. One only (bore-hole 12) passed through undoubted boulder clay. The section was—

		Feet.
Palæolithic.	Yellow brickearth and small stones ..... { dug	9
	{ bored	5½
Ancient alluvium.	Yellow and white marl and silt	2
	Yellow loam and small chalk pebbles	½
Glacial.	Chalky boulder clay	9
	Loamy chalky gravel (base of the Boulder Clay)...	2
	Gravelly sand (boring stopped by large stones) ...	8
		36

The site of this boring is close to the western margin of the old channel, chalk appearing at the surface within a short distance. The occurrence of the chalky Boulder Clay at this spot at a high level, and its absence, or representation by derivative material, at lower levels in borings made nearer to the centre of the channel, suggest that the channel was, to a large extent, excavated, or re-excavated, after the deposition of the Boulder Clay, as was the case at Hoxne.

The course of the ancient silted-up channel cannot yet be defined. Loam with Palæolithic implements occupies a belt extending for about a mile south of Hitchin. It has been extensively worked at various times between Windmill Hill and Maydencroft Lane. According to Mr. Hill, implements have also been found on Thistly Farm, half a mile further south. The only pits now worked are those known as "Ransom's" and "Jeeves'."

The underlying river alluvium is entirely overlapped and hidden by the Palæolithic brickearth, and is only to be seen where the brickearth has been dug away. It is found in Ransom's and Jeeves' brickyards, and we have now discovered it, half a mile to the S.S.W., in two borings on Maydencroft Farm. It apparently occupies a narrow belt in the middle of the old valley. The

greatest depth of this valley could not be proved, owing to the running sand and gravel, which made boring so difficult. The bottom lies at least as low as the level of the existing valleys of the Hiz and Purwell, for five different borings were abandoned at about that level, without having reached the Chalk. The trend of the buried channel seems to be from south to north, in this following the general slope of the ground and running parallel to the course of the existing streams.

Work was commenced in November, 1896, in Ransom's brickyard, one boring being put down at the east corner and another at the south end. The section at the east corner showed 30 feet of Palæolithic loam, resting on 25 feet of carbonaceous loam with fresh-water shells, below which came 12 feet of loamy sand and gravel of doubtful age—perhaps Glacial, perhaps later. At the south end bore-hole 2 showed—

		Feet.
Dug.	Brickearth with small scattered stones and occasional Palæolithic implements, bedding obscure and irregular	30
	Bedded brickearth with seams of sand (should be searched for Arctic plants; compare Bed C at Hoxne)	8
	White marly sand with fresh-water shells and fish teeth	1 to 3½
	Gravelly brickearth	½ to 2½
Bored.	Sandy loamy gravel	9
	Brickearth	2
	Loamy gravelly sand, full of water	6
	Blue clay and chalk — Base of the Boulder Clay, or reconstructed boulder clay	3
	Blue coarse loamy sand — Base of the Boulder Clay, or reconstructed boulder clay	1
	Blue hard chalky loam — Base of the Boulder Clay, or reconstructed boulder clay	1
	Sandy gravel and water	3

Other borings in Jeeves' Yard and near Maydencroft Farm yielded similar results, but only the one already mentioned (bore-hole 12) reached undoubted Boulder Clay below the alluvial strata.

The relation of the Boulder Clay to the alluvial deposits having been settled, attention was devoted to an attempt to penetrate to the bottom of the valley in its deepest part. A trial-pit was sunk in Ransom's old brickyard, within a few yards of the spot where a pit had been sunk by Messrs. Prestwich and Evans in 1877, and samples were taken from various depths for washing and minute examination in London. In this brickyard a large number of implements had been obtained from the irregular gravelly base of the brickearth, where it rests on the older alluvial deposits. The newer brickearth, here about 24 feet thick, had been already entirely removed at the spot where the trial-pit was sunk, and it was hoped that the pit could be sunk to the full depth of the old channel. After sinking 14 feet through brown bedded carbonaceous loam, full of badly preserved shells and plant-remains, the weather became so unsettled that there was a fear of the pit caving in, or becoming flooded, before the work was completed. Boring tools were therefore used, and a further depth of 17½ feet of alluvial loam was penetrated before the gravelly sand below was reached. At the base of the alluvium was found a foot or

so of hard black loam with fresh-water shells and fragments of Jurassic fossils derived from the Boulder Clay. As the quicksand below could not be penetrated without the expenditure of more time and money than could fairly be devoted to such unsatisfactory work, the boring was then abandoned.

In working out the material afterwards, it became evident that from top to bottom the alluvial deposits below the Palæolithic brick-earth belonged to one series, the same plants occurring throughout. We have therefore only two deposits to deal with—a stony brick-earth yielding little or nothing but Palæolithic implements, and a series of ancient alluvial deposits below full of plants and shells, but, so far as known, without trace of man. The mammalian remains all come, I am informed, from the whitish marly silt which occurs locally immediately below the Palæolithic brickearth. They are mostly in Mr. W. Ransom's collection, and were determined by Mr. Sanford. The remainder of the animals and plants, with the exception of two species of mollusca, were obtained in the trial-pit just described. For the determination of the fishes, I must thank my colleague, Mr. E. T. Newton; for the mosses, Mr. W. Mitten; and for the mollusca and flowering plants I am responsible.

*Mammals.**

Ursus; Equus caballus, *Linn.*; Rhinoceros; Hippopotamus (a waterworn bone); Cervus elaphus, *Linn.*; Elephas primigenius, *Blumb.*

Fishes.

Perca fluviatilis, *Linn.*; Esox lucius, *Linn.*; Leuciscus rutilus, *Linn.*; Leuciscus erythrophthalmus, *Linn.*; Tinca vulgaris, *Cuv.*

Insects.

Elytra of several genera of beetles, badly preserved; Galls.

Mollusca.

Helix pulchella, *Müller*; Clausilia biplicata, *Mont.*; Carychium minimum, *Müller*; Planorbis albus, *Müller*; Planorbis carinatus, *Müller* (recorded by Mr. E. T. Newton); Planorbis complanatus, *Linn.*; Planorbis nautileus, *Linn.*; Planorbis nitidus, *Müller*; Planorbis spirorbis, *Müller* (found by Mr. A. S. Kennard); Limnæa auricularia, *Linn.*; Limnæa peregra, *Müller*; Limnæa stagnalis, *Linn.*; Velletia lacustris, *Linn.*; Valvata piscinalis, *Müller*; Valvata cristata, *Müller*; Bythinia Leachii, *Shepp.*; Bythinia tentaculata, *Linn.*; Pisidium pusillum, *Gmel.*; Sphærium corneum, *Linn.*; Anodonta.

Flowering Plants.

Ranunculus aquatilis, *Linn.*; Ranunculus sceleratus, *Linn.*; Ranunculus repens, *Linn.*; Montia fontana, *Linn.*; Prunus spinosa,

* Mr. W. Ransom reports that since the lake deposit was visited by Mr. Reid there have been found in it teeth and bones of *Bos primigenius*, of *Ursus arctos*, and of two varieties of deer, associated with flint-implements.—Ed.

Linn.; Poterium officinale, *Hook. f.*; Pyrus torminalis? *Ehrh.* (identical with seeds found at Hoxne); Hippuris vulgaris, *Linn.*; Myriophyllum; Cornus sanguinea, *Linn.*; Sambucus nigra, *Linn.*; Eupatorium cannabinum, *Linn.*; Fraxinus excelsior, *Linn.*; Menyanthes trifoliata, *Linn.*; Lycopus europæus, *Linn.*; Ajuga reptans, *Linn.*; Alnus glutinosa, *Linn.*; Quercus robur, *Linn.*; Ceratophyllum demersum, *Linn.*; Sparganium; Potamogeton crispus, *Linn.*; Potamogeton, sp.; Potamogeton, sp.; Naias marina, *Linn.*; Scirpus lacustris, *Linn.*; Scirpus, sp.; Carex.

Mosses.

Antitrichia curtipendula, *Brid.*; Homalothecium sericeum, *Bry. Europ.*; Hyocomium brevirostre? *Bry. Europ.*; Isothecium?; Neckera complanata, *Bry. Europ.*; Stereodon cupressiformis, *Brid.*; Zygodon?

Characeæ.

Several species *indet.*

Such trees as the oak, ash, sloe, cornel, elder, and alder point unmistakably to a temperate climate, and the fauna and flora as a whole suggest climatic conditions not differing greatly from those we now enjoy. Mr. Mitten writes of the mosses, that "all these are inhabitants of a sylvan temperate region . . . . and none point to a different environment from that now existing; they are not arctic." The occurrence of *Naias marina*, now only found in Britain in two of the Norfolk Broads, is singular, though the plant was evidently more common in former times than it is at the present day. It has now been discovered in the Pre-Glacial deposits of Norfolk and Suffolk, beneath Palæolithic remains at Hitchin, and in a submerged peat of Neolithic date at Barry Docks, in South Wales.

The resemblance of the Hitchin Palæolithic brickearth to the Palæolithic brickearth of Hoxne, and the similarity of the old alluvia beneath, both in fossil contents and in the physical changes they suggest, are so striking that one is compelled to correlate them bed by bed. If, however, this correlation be correct, it is evident that the intermediate deposit full of leaves of Arctic willows, so conspicuous over part of the area at Hoxne, is missing at Hitchin. At each locality the same story is told. Some time after the passing away of the ice the land stood higher than now, so that the streams had a greater fall and valleys were cut to a somewhat greater depth. Then the land sank and the valleys became silted up with layer after layer of alluvium, to a depth of at least 30 feet, the climate remaining temperate. The next stage, when an Arctic flora reappeared, is only represented at Hoxne. The third stage in the infilling of the valleys is shown in the curious unstratified decalcified brickearth with scattered stones and Palæolithic implements, identical in character at Hitchin, Hoxne, Fisherton, and other localities, which irresistibly suggests a mingling of wind-transported material and rainwash.

It may be pointed out that if this hypothesis of the origin of the Palæolithic brickearth during the reign of "steppe" conditions be accepted, it will account for the non-correspondence of the ancient channels with the present valleys, a thing very difficult to explain if the infilling were caused by ordinary fluviatile action. If the Palæolithic brickearth be equivalent to the Palæolithic loess of the ancient deserts in Central Europe, we can understand how during this period of cold and drought the smaller streams ceased to flow and their valleys became so filled with rainwash and dust that when a moister climate recurred the streams had to seek new channels.

APPENDIX.

Borings made at Hitchin in November and December, 1896.

1. In Ransom's new brickyard, east corner. Surface about 268 feet above Ordnance Datum. Work stopped by running sand and water.

		Feet.
Palæolithic.	Brown brickearth, with a few stones and occasional Palæolithic implements; bedding obscure and irregular. (Dug to about 25 feet, bored 5 feet.)	30
Ancient alluvium.	Brown loam, rather stiffer, with fresh-water shells	2
	Brown sandy brickearth and a few stones	11
	Brown sandy brickearth and traces of fresh-water shells.	4
	Blacker loam. *Bythinia*, *Limnæa*, and boulder-clay fossils	7
Glacial?	Brown brickearth	1
	Gravelly loam	1
	Brown loamy sand and stones	2½
	Blue loamy sand and gravel, full of water	8½
		67

2. In Ransom's new brickyard, south end. Surface about 270 feet (see p. 17).

3. Close to the old brick-pit east of New England. Surface about 235 feet.

	Soil	1
Palæolithic?	Brickearth and small stones	1
	Gravelly brickearth	1½
	Coarse loamy and gravelly sand	½
	Hard sandy and gravelly brickearth	2
	Loamy gravel	1
		7

No attempt to go deeper was made at this spot.

4. Preliminary trial in old brick-pit N.N.E. of Maydencroft Farm (south side of the Charlton Road). Surface about 260 feet.

Palæolithic.	Brickearth. (Dug 11 feet, bored 2 feet.)	13
Ancient alluvium.	White marl with fresh-water shells	4
	Blackish loamy sand	½
	Black loam, with fresh-water shells and traces of plants	1
		18½

For lower beds see bore-hole 8.

5. Jeeves' Yard, north corner. Surface about 246 feet.

		Feet.
Palæolithic.	Brown brickearth, bedding obscure, occasional Palæolithic implements. (Dug.)	11
Ancient alluvium.	Shell marl. A few yards from this spot large bones have been obtained from this bed	9
	Stony brickearth	10
Glacial?	Fine, rather loamy, gravel, full of water	14
		44

6. Jeeves' Yard, south-west of bore-hole 5. Level (of present surface) about 240 feet.

	Made ground	1
Ancient alluvium.	Brown sand (decalcified shell marl?)	13½
	Brown brickearth (boring stopped by a large stone)	4
		18½

7. Jeeves' Yard, north-east part, near the pump. Level (of present surface) about 238 feet.

Palæolithic.	Brickearth (already removed)	10
Ancient alluvium.	Shell marl, with *Valvata piscinalis*, etc.	8
	Black loam with fish-bones, fresh-water shells, seed of alder, and *Naias marina*	7
	Thin seam of small lignite.	
	Laminated brown and white loam, more sandy. Obscure vegetable remains	10
	Lighter-coloured very soft loam	2
		37

8. In old brick-pit N.N.E. of Maydencroft Farm and on south side of the Charlton Road (close to bore-hole 4). Level of old surface about 260 feet.

Palæolithic.	Brickearth, already removed	14
	do. dug	1
Ancient alluvium.	White calcareous silt, with carbonaceous seams, *Bythinia*, and fish-bones	2
	Yellow loam, darker below	3
	Seam of fish-bones.	
	Yellow loam	½
	White silt / Brown silt	½
	Black loam with fresh-water shells and seeds	7
	Stiffer black loam with traces of plants	4
	Stiff, hard, blue-black clay with small roots	½
Glacial?	Coarse, blackish, loamy sand	½
		33

9. Roadside close to paths to Maydencroft Farm and Priory Park. Surface about 273 feet.

	Brickearth and numerous stones	3

10. Close to bore-hole 12 (which see).

11. Roadside south of Priory Park, $\frac{1}{4}$ mile east of Charlton.

		Feet.
	Soil	1
Ancient alluvium, decalcified? or Glacial.	Sandy and stony brickearth	3
	Yellow sandy gravel	3
	Yellow sand	4
	Yellow gravelly sand	1
	Loamy sand	4
	Laminated reddish-brown loam	2
	Sand, darker and rather loamy	3
		21

12. In old brick-pit 90 yards S.S.W. of the Charlton Road and close to path to Maydencroft Farm. Level (of old surface) 271 feet.

Palæolithic.	Yellow brickearth with small stones (9 feet already removed)	$14\frac{1}{2}$
Ancient alluvium.	Yellow and white marl and silt (compare bore-hole 8)	2
	Yellow brickearth and small chalk pebbles	$\frac{1}{2}$
Glacial.	Chalky boulder clay	9
	Loamy chalky gravel	2
	Gravelly sand	8
		36

13. Old gravel-pit in Jeeves' Yard, near Black Horse Lane. Level (of old surface) 242 feet.

Glacial.	Coarse gravel, becoming finer below. (Dug.)	18
	Finer gravel, watery below. (Bored.)	$10\frac{1}{2}$
		$28\frac{1}{2}$

14 and trial-pit (see p. 17).

III.

REPORT ON THE RAINFALL IN HERTFORDSHIRE IN THE YEAR 1897.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

Read at Watford, 22nd March, 1898.

There are a few alterations in our rainfall stations, but the number is the same as in the previous year, namely 44. Two stations disappear from our list — Elm House, Tring, no reply having been received to my applications for the return; and the Cowroast station of the Grand Junction Canal Company, omitted owing to errors in the record. On the other hand there are two stations added—the London Orphan Asylum, Watford, and 215 St. Albans Road, Watford. Mr. Fordham's gauge at Odsey is a new one, placed three feet north-west of the old one, and on the same level.

The number of daily records received is 35, which is the same as in the previous year.

Particulars of the 44 rainfall stations, and the monthly and total rainfall and number of days of rain in the year 1897, as usually computed, are given in Tables I and II, pp. 25–27.

A supplementary table (Table III, p. 28) gives eight other records of the total rainfall in the year. Two are the records of additional gauges at Rothamsted, and six are taken from Symons' 'British Rainfall, 1897.'

The mean rainfall in the county in the year 1897 was 24·87 inches. This is 1·87 inch below the average for the decade 1880–98, and 1·56 inch below that for the half-century 1840–89. The year was, therefore, one of rather small rainfall. The mean number of wet days in the year was 166, being two less than the average for the twenty years 1870–89.

The most remarkable feature in the year's rainfall is the very small fall in October and November, which are usually about the wettest months in the year. Next to these months in amount of rainfall usually comes July, and this month, in 1897, had the least fall in the year. That a single month should differ greatly from the average is by no means exceptional, but it is remarkable that two months in succession in the (usually) wettest part of the year should have together anything like so little rain as 7·8 per cent. of the year's fall, as was the case with October and November, 1897. As a rule the second half of the year is much the wetter of the two, but this year the first half had 56 per cent. of the year's fall, while the second half had only 44 per cent.

Droughts in 1897.—Accepting as before Mr. Symons' definitions of "absolute" and "partial" droughts, there were two absolute droughts in 1897 and there was one partial drought, but they were not general over the county, one of the absolute droughts occurring

only at 6 of the 35 stations for which I have the daily rainfall, and the other at 11, and the partial drought occurring only at 8 stations.

The first absolute drought lasted for 20 days, May 5 to 24, at one station (Fairhill, Berkhamsted); for 19 days, May 6 to 24, at one (Weston Park, Stevenage); for 18 days, May 7 to 24, at one (Royston); and for 15 days, May 11 to 25, at three stations (in the Lea river-basin); its average duration being 17 days.

The second absolute drought lasted for 20 days, June 29 to July 18, at eight stations (one in the Cam, one in the Colne, and six in the Lea river-basin); for 19 days, June 30 to July 18, at two stations (in the Lea); and for 18 days, July 1 to 18, at one station (High Down, Hitchin); its average duration being 19½ days.

The partial drought lasted for 29 days, June 20 to July 18, at two stations; for 30 days, June 19 to July 18, at one of these (Royston); for 30 days, June 25 to July 24, at six stations; for 31 days, June 25 to July 25, at two of these; and for 43 days, June 25 to August 6, at one of these (Much Hadham). With the exception of Royston, all the stations with this partial drought are in the river-basin of the Lea. Its average duration was 31½ days, and the average rainfall was 0·0075 in. per day.

Distribution of Rainfall throughout the Year.—Of the total rainfall of 24·87 inches, 8·38 ins. fell during the first quarter of the year, 5·59 ins. during the second, 6·24 ins. during the third, and 4·66 ins. during the fourth. During the winter of 1896–97 (Dec. to Feb.) 8·48 ins. fell, during the spring of 1897 (March to May) 6·73 ins., during the summer (June to August) 6·34 ins., and during the autumn (Sept. to Nov.) 4·66 ins. March was very wet, and August and December were also wet months; July, October, and November were very dry; February, June, and September were rather wet; April and May were rather dry. The aggregate rainfall in the three wet months was nearly four times as much as in the three dry ones.

The difference in each month from the mean for the half-century was as follows:—Jan. —0·20, Feb. +0·87, March +2·08, April —0·13, May —0·74, June +0·45, July —1·77, August +0·68, Sept. +0·02, Oct. —2·14, Nov. —1·56, Dec. +0·88.

The absolute maximum falls in any one day in each month, and the stations recording them, were—Jan. 8, Kensworth, 0·85 in.; Feb. 1, Northchurch, 1·13 in.; March 17, New Barnet, 0·83 in.; April 28, The Firs, Hitchin, and 30, Great Gaddesden, 0·43 in.; May 31, Marden Hill, Tewin, 0·84 in.; June 24, Colne Valley Waterworks, Watford, 1·40 in.; July 26, Southgate, East Barnet, 2·57 ins.; August 18, Weston Park, Stevenage, 1·54 in.; Sept. 29, Southgate, 1·21 in.; Oct. 25, Bulbourne, Tring, 0·34 in.; Nov. 28, High Down, Hitchin, 0·54 in.; Dec. 29, Offside Cottage, Cowroast, 0·95 in.

The day in each month on which a heavy fall of rain was most general over the county was—Jan. 8, Feb. 4, March 2, April 17 (and 30), May 30, June 8, July 26, August 18 (and 30), Sept. 29, Oct. 18, Nov. 27, Dec. 7.

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS, 1897.

District.	Station.	Observer.	Diameter of Gauge.	Height of Gauge above Ground.		Height of Gauge above Sea-level.
			ins.	ft.	ins.	ft.†
1.	*Royston	Hale Wortham	8	0	6	269
,,	*Odsey	H. George Fordham	5	1	0	256
3.	Hitchin—The Firs	William Lucas	5	2	1	238
,,	* ,, Bancroft	Francis Ransom	5	0	9	212
,,	,, The Maples	William Hill	8	1	1	220
,,	* ,, High Down	Joseph Pollard	5	1	3	422
4.	Tring—Pendley Manor	J. G. Williams	5	2	0	500 ?
,,	,, Bulbourne	Gordon Thomas	5	2	3	401
6.	*Cowroast—Offside Cottage.	Richard Leah	5	1	6	420 ?
,,	*Northchurch—The Limes	F. L. Sutton	5	1	0	400 ?
,,	*Berkhamsted—Rosebank	Edward Mawley	8	1	0	401
,,	* ,, Fairhill	W. Bonner Hopkins	5	1	0	548
7.	*Great Gaddesden Vicarage	Rev. W. T. Drake	8	1	0	427
,,	*H. Hempstead—Apsley Mills	J. Dickinson & Co.	24	0	9	260
,,	* ,, Nash Mills	,,	12	3	9	237
,,	Kg.'s Langley—Laurel Bank	Isaac Butler	5	1	0	283
8.	*Kensworth—The Grove	Miss S. Grace Jones	5	1	0	630 B
,,	Harpenden—Rothamsted	Lawes and Gilbert	5	0	9	420
,,	*St. Albans—Gorhambury	W. Newberry	5	1	0	423
,,	* ,, The Grange	John Hopkinson	5	1	0	380
,,	* ,, Boue Hill	H. J. T. Broadwood	5	1	0	336
9.	* Elstree—Aldenham House	Edwin Beckett	10 sqr.	4	9	305
10.	* Watford—St. Alban's Road	H. Ruddle	5	1	0	250 ?
,,	* ,, London Orphan Asylum	Dr. O. C. Cockrem	5	1	0	230
,,	* ,, Frogmore	Arthur P. Blathwayt	5	1	0	182
,,	,, Colne Val. Water W'ks.	William Verini	5	1	0	220
,,	*Rickmansworth—Moor Park	Lord Ebury	5	2	0	340
12.	*Welwyn—Bridge House	B. Wilfred Thomas	5	0	6	228 ?
,,	*Datchworth Rectory	Rev. J. Wardale	5	1	0	386
,,	Hertford—Marden Hill	Richard Hoare	5	1	0	257
13.	*Stevenage—Weston Park	M. R. Pryor	5	0	8	470
,,	* ,, Bennington House	Rev. Dr. Parker	5	1	0	408
14.	*Therfield Rectory	Rev. J. G. Hale	5	4	0	510
,,	*Throcking Rectory	Rev. C. W. Harvey	5	1	0	484
,,	*Buntingford—Hamels Park	E. Wallis	5	1	0	400
15.	*Much Hadham	T. Woodham Mott	5	1	0	222 B
16.	Sawbridgeworth—Cowicks	Harry W. Towse	6	1	0	240
17.	*Hertford—Bayfordbury	W. Clinton Baker	8	1	2	250
,,	*Ware—Red House	Joseph Francis	5	0	9	112
,,	* ,, Fanhams Hall	Miss Joyce Croft	8	1	0	253
18.	*Broxbourne—Stafford House	G. J. Newbery	5	1	0	118
,,	*Cheshunt—Old Nurseries	Paul and Son	5	1	0	92
,,	*New Barnet—Gas Works	T. H. Martin	8	0	9	212
,,	*Southgate—The Lawns	George A. Church	5	0	6	240

* Daily fall received. † For explanation of these symbols see Vol. VII, p. 53.

TABLE II.—RAINFALL IN

River District.		Station.	Jan.	Feb.	Mar.
			ins.	ins.	ins.
OUSE / Cam	1. Rhee	Royston	2·24	2·33	3·55
		Odsey	1·93	2·26	3·59
OUSE / Ivel	3. Hiz	Hitchin—The Firs	2·25	2·34	4·13
		,, Bancroft	2·35	2·43	4·20
		,, The Maples	2·31	2·33	4·07
		,, High Down	2·39	2·10	3·90
THAMES / Thame	4. Up. Thame	Tring—Pendley Manor	2·48	2·98	3·96
		,, Bulbourne	2·16	2·48	3·56
THAMES / Colne	6. Bulbourne	Cowroast—Offside Cottage	2·61	2·92	3·82
		Northchurch—The Limes	1·50	3·56	4·16
		Berkhamsted—Rosebank	2·63	2·87	4·08
		,, Fairhill	2·21	2·85	3·89
	7. Gade	Great Gaddesden Vicarage	2·21	2·90	4·09
		Hemel Hempstead—Apsley Mills	2·17	2·96	4·26
		,, Nash Mills	1·83	2·54	3·66
		King's Langley—Laurel Bank	2·08	2·79	4·16
	8. Ver	Kensworth—The Grove	2·27	3·30	3·68
		Harpenden—Rothamsted	1·84	2·74	3·94
		St. Albans—Gorhambury	2·22	2·68	3·94
		,, The Grange	2·30	2·56	3·64
		,, Bone Hill	1·76	2·37	3·48
	9. Up. Colne	Elstree—Aldenham House	1·42	1·70	2·48
	10. Lo. Colne	Watford—St. Albans Road	1·96	2·62	3·73
		,, London Orphan Asylum	1·88	2·46	3·50
		,, Frogmore	1·90	2·51	3·60
		,, Colne Valley Water Works	1·95	2·45	3·57
		Rickmansworth—Moor Park	2·16	3·23	4·75
THAMES / Lea	12. Mimram	Welwyn—Bridge House	2·50	2·49	3·79
		Datchworth Rectory	2·09	2·65	2·98
		Hertford—Marden Hill	2·43	2·54	2·74
	13. Beane	Stevenage—Weston Park	1·40	2·81	3·98
		Bennington House	2·13	2·48	3·18
	14. Rib	Therfield Rectory	2·38	2·55	3·45
		Throcking Rectory	1·99	2·49	3·58
		Buntingford—Hamels Park	2·27	2·53	3·35
	15. Ash	Much Hadham	2·26	2·68	4·06
	16. Stort	Sawbridgeworth—Cowicks	2·19	2·56	3·71
	17. Upper Lea	Hertford—Bayfordbury	2·21	2·40	3·19
		Ware—Red House	1·99	2·28	3·48
		,, Fanhams Hall	2·35	2·42	3·51
	18. Lower Lea	Broxbourne—Stafford House	1·90	2·24	3·39
		Cheshunt—Old Nurseries	1·71	1·83	2·79
		New Barnet—Gas Works	2·11	2·63	4·00
		Southgate—The Lawns	2·08	2·75	3·76
Mean for the County			2·11	2·58	3·69

Hertfordshire in 1897.

Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Days.
in.	ins.	ins.	ins.	ins.	ins.	in.	in.	ins.	ins.	
1·44	1·04	2·14	·48	3·17	2·80	·69	·88	1·83	22·59	167
1·60	1·42	2·19	1·08	2·82	3·10	·77	·89	1·66	23·31	165
1·77	1·12	2·33	·80	2·07	1·90	·62	1·15	2·32	22·80	168
1·72	1·13	2·33	·99	2·08	1·98	·64	1·25	2·41	23·51	169
1·64	1·14	2·40	·73	1·99	1·92	·61	1·46	2·21	22·81	156
1·73	1·29	2·10	·23	2·71	2·07	·82	1·35	2·26	22·95	179
1·66	1·42	2·16	·88	4·07	2·52	1·11	·89	3·72	27·85	203
1·68	1·36	2·16	·58	3·64	2·39	1·06	·89	3·29	25·25	175
1·78	1·34	2·18	·51	3·50	2·41	1·07	1·00	3·96	27·10	187
1·79	1·32	2·44	·61	3·08	2·16	·92	·99	3·57	26·10	145
1·68	1·19	2·77	·55	3·32	2·05	·86	1·05	3·41	26·46	169
1·74	1·19	2·79	·67	2·93	1·96	·84	1·01	3·18	25·26	189
1·95	1·11	2·88	·65	2·86	2·08	·80	1·06	3·60	26·19	164
1·68	1·35	3·23	·58	3·28	2·41	·91	1·10	3·96	27·89	164
1·46	1·12	2·70	·46	2·54	2·19	·73	·84	3·37	23·44	148
1·76	1·38	3·10	·61	3·12	2·76	·89	1·02	3·95	27·62	
1·99	1·34	2·06	·56	3·23	2·55	·89	1·11	3·44	26·42	156
1·77	1·63	2·59	·44	3·08	2·29	·86	·97	3·26	25·41	169
1·82	1·41	2·75	·39	2·92	2·11	·82	·91	3·70	25·67	166
1·77	1·35	2·66	·60	2·89	2·45	·86	·95	3·41	25·44	176
1·79	1·29	2·77	·30	2·92	2·43	·85	·96	3·33	24·25	166
1·58	1·14	2·30	1·16	4·12	2·12	·96	1·08	3·20	23·26	
1·64	·99	2·97	·73	3·60	2·48	·73	·84	3·18	25·47	
1·73	1·25	3·22	1·14	3·57	2·68	·81	·95	3·27	26·46	166
1·64	1·19	3·35	·96	3·40	2·44	·72	·93	2·99	25·63	166
1·52	1·28	3·36	·91	3·38	2·33	·81	·99	2·99	25·54	165
1·97	1·42	3·37	·22	3·45	2·18	1·02	1·11	3·60	28·48	173
1·46	1·70	2·09	·38	2·65	2·54	·75	·89	2·86	24·10	161
1·32	1·99	1·97	·26	2·17	2·25	·70	·78	2·53	21·69	147
1·66	2·04	2·54	·37	2·07	2·06	1·15	·68	2·31	22·59	151
1·96	1·41	2·41	1·72	4·57	2·77	·78	1·35	2·57	27·73	166
1·26	1·61	1·99	·62	2·52	2·90	·79	·84	2·38	22·73	174
1·50	1·31	2·72	1·23	3·49	3·02	·85	1·08	1·91	25·49	166
1·65	1·66	1·61	·91	2·73	2·62	·78	1·18	2·21	23·41	177
1·52	2·00	2·12	·38	2·77	2·56	·71	·86	2·33	23·40	150
1·61	1·25	2·32	·23	3·10	2·93	·85	1·13	2·80	25·22	158
1·61	1·57	2·58	·45	5·05	3·03	·78	1·11	2·60	27·24	159
1·46	1·35	2·40	·61	2·39	2·27	·74	·96	2·51	22·49	167
1·40	1·53	2·31	·41	2·59	2·68	·64	·93	2·23	22·47	147
1·42	1·34	2·86	·61	2·83	2·54	·79	1·02	2·03	23·72	165
1·42	1·18	2·35	·43	3·27	2·92	·60	·86	2·55	23·11	164
1·38	1·55	2·53	·40	2·70	2·25	·51	·81	2·21	20·67	141
1·73	1·42	3·09	1·92	2·73	2·60	·61	·99	2·74	26·57	
1·81	1·91	2·99	3·14	3·54	2·97	·73	1·07	1·88	28·63	189
1·65	1·39	2·55	·73	3·06	2·45	·80	1·00	2·86	24·87	166

Table III.—Supplementary to Tables I and II.

District.	Station.	Observer.	Gauge.		Rain-fall.	Days.
			Dia-meter.	Height above Sea.		
			ins.	feet.	ins.	
1.	Royston—Melbourne St.	J. E. J. Phillips..	8	201 T	22·81	152
2.	Baldock—Hitchin St.	Dr. Langston Day	5	214 T	22·87	158
8.	Harpenden—Rothamsted	Sir J. Lawes and Sir H. Gilbert.....	8	420 T	24·97	154
,,	,, ,,		72 × 87	420 T	27·17	181
10.	Chipperfield	A. W. Rivington.	5	407 T	26·32	
,,	Watford—Oaklands	E. Harrison	5	273	26·87	167
12.	Welwyn—Danesbury	A. M. Blake.....	5	400	24·42	152
13.	Bennington	Miss C. Nihill	5	408	23·81	173

The average number of wet days in each month was as follows:—Jan., 18; Feb., 14; March, 20; April, 14; May, 10; June, 12; July, 6; August, 17; Sept., 14; Oct., 11; Nov., 12; Dec., 18; giving a total for the year of 166.

The deviation from the mean for the 20 years 1870–89 was—Jan., +3; Feb., =; March, +7; April, +1; May, —3; June, —1; July, —8; August, +4; Sept., +1; Oct., —2; Nov., —4; Dec., +2.

Distribution of Rainfall throughout the County.—The following table (Table IV) gives the mean fall in each month and for the year in each of the five river-districts represented, and in the two main hydrographical divisions of the county, the catchment-basins of the Great Ouse and the Thames, and also the difference in the year from the mean for the decade 1880–89.

Table IV.—Rainfall in the River-districts.

Months.	Cam.	Ivel.	Thame.	Colne.	Lea.	Ouse.	Thames.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	2·09	2·32	2·32	2·05	2·12	2·25	2·09
Feb.	2·29	2·30	2·73	2·74	2·49	2·30	2·63
March	3·57	4·08	3·76	3·81	3·47	3·91	3·66
April	1·52	1·72	1·67	1·74	1·54	1·65	1·65
May	1·23	1·17	1·39	1·28	1·58	1·19	1·42
June	2·16	2·29	2·16	2·82	2·40	2·25	2·59
July	·78	·69	·73	·63	·83	·72	·73
August	3·00	2·21	3·85	3·22	3·01	2·47	3·16
Sept.	2·95	1·97	2·46	2·32	2·64	2·29	2·47
October	·73	·67	1·08	·86	·75	·69	·82
Nov.	·88	1·30	·89	·99	·97	1·16	·98
Dec.	1·75	2·30	3·51	3·44	2·39	2·12	2·97
Year	22·95	23·02	26·55	25·90	24·19	23·00	25·17
Diff. from 1880-89	—0·55	—2·25		—3·07	—1·36	—1·48	—1·98

The mean fall in each of the minor river-basins or sub-districts represented was as follows:—(*Cam*) Rhee, 22·95 ins.;—(*Ivel*) Hiz, 23·02 ins.;—(*Thame*) Upper Thame, 26·55 ins.;—(*Colne*) Bulbourne, 26·23 ins.; Gade, 26·28 ins.; Ver, 25·43 ins.; Upper Colne, 23·26 ins.; Lower Colne, 26·30 ins.;—(*Lea*) Mimram, 22·79 ins.; Beane, 25·23 ins.; Rib, 24·10 ins.; Ash, 25·22 ins.; Stort, 27·24 ins.; Upper Lea, 22·89 ins.; Lower Lea, 24·75 ins.

The total yearly fall ranged from 20·67 inches at Cheshunt to 28·63 inches at Southgate; and the total monthly fall from 0·23 inch at Much Hadham in July to 5·05 inches at Cowicks, Sawbridgeworth, in August. The greatest fall in any one day was 2·57 ins. at Southgate on the 26th of July.

Distribution of the Rainfall in each Month.—The nomenclature used in the following account of the chief falls of rain is the same as in my previous reports, falls of at least ½ inch being styled *considerable*, ¾ inch *very considerable*, 1 inch *great*, 1¼ inch *very great*, 1½ inch *heavy*, 1¾ inch *very heavy*, and 2 inches *excessive*. This analysis only applies to the thirty-five stations for which I have returns of the daily rainfall. The wettest days which are given in each month are those at forty-two stations.

January.—Rather dry on the whole, but with much snow in the second half of the month, and with more than the usual number of wet days. On the 8th the fall was *considerable* at twenty-four stations and *very considerable* at two, and on the 22nd it was *considerable* at one (Cowroast). The 7th was the wettest day at one station, the 8th at forty stations, and the 6th and 22nd were the wettest at one station. Mr. Bonner Hopkins reports that on the 22nd snow fell at Fairhill, Berkhamsted Common, to the depth of 3 inches, which should have shown about 0·25 in. of water in the gauge, but that there was only 0·15 in. in it.

February.—A wet month, with snow during the first week, and about the usual number of wet days. On the 1st the fall was *considerable* at six stations and *great* at Northchurch (1·13 in.), on the 4th it was *considerable* at thirteen stations, and on the 5th *considerable* at eight. The 1st was the wettest day at twelve stations, the 2nd at one station, the 4th at twenty-one stations, the 5th at seven, and the 1st and 4th were the wettest at one station. There were floods in the early part of the month, some account of which is given as an appendix.

March.—A very wet month, with snow at the beginning and end, and a large number of wet days. On the 2nd the fall was *considerable* at twenty-nine stations and *very considerable* at two, and on the 17th *considerable* at eight and *very considerable* at two. The 2nd was the wettest day at thirty-eight stations, the 17th at three, and the 2nd and 17th at one station.

April.—Rainfall a little below the average for the month and on about the usual number of days. A little snow fell during the first week. On no day was there a *considerable* fall of rain. The 16th was the wettest day at ten stations, the 17th at three, the 19th at one station, the 21st at one, the 28th at one, the 30th at

thirteen stations, the 31st at one station, the 15th and 16th were the wettest at one, and the 16th and 17th at one.

MAY.—A dry month, with rain on a small number of days, but sometimes rather heavy. On the 26th the fall was *considerable* at one station (Hamels Park), and on the 30th it was *considerable* at nine stations and *very considerable* at two. The 26th was the wettest day at one station, the 30th at thirty-five stations, and the 31st at six.

JUNE.—A wet month, with rain on about the usual number of days, the amount of rain being due to heavy falls rather than continued wet weather. On the 8th the fall was *considerable* at two stations and *very considerable* at twenty-two, *great* at Odsey (1·01 in.), Bennington House, Much Hadham, and Southgate (1·02 in.), Bayfordbury (1·04 in.), Royston (1·05 in.), Fanhams Hall, Ware (1·07 in.), and Therfield Rectory (1·11 in.). On the 24th it was *considerable* at four stations, *very considerable* at five, *great* at the London Orphan Asylum, Watford (1·15 in.), and *very great* at New Barnet (1·28 in.), Frogmore, Watford (1·36 in.), and Moor Park (1·40 in.). The 8th was the wettest day at thirty-three stations and the 24th at nine. On this day (24th) there was a severe hailstorm, which Mr. Pollard, of High Down, Hitchin, reports as very destructive in the narrow line of its course from Harpenden over Luton, Offley, Pirton, Shillington, Henlow, and Langford. About 200 panes of glass were broken at High Down. On this and other days there were thunderstorms in various parts of the County.

JULY.—An exceedingly dry month, the rainfall being between one-third and one-fourth the average and on less than half the usual number of days. The few heavy falls were due to thunderstorms. On the 20th the fall was *considerable* at three stations, and *very great* at Weston Park (1·42 in.), and on the 26th it was *considerable* at two stations (Watford and Elstree), *great* at New Barnet (1·19 in.), and *excessive* at Southgate (2·57 ins.). The 19th was the wettest day at five stations, the 20th at seven, the 21st at three, the 25th at four, the 26th at twenty-one, and the 27th at two. Mr. Church reports that during the storm on the 26th there fell at The Lawns, Southgate, between 5 and 6.30 p.m., 2·50 inches of rain, 0·07 in. falling afterwards. An oak-tree about 50 yards from the house was struck by the lightning, split into four parts, and entirely deprived of its bark to the height of eight feet from the ground.

AUGUST.—A very wet month, with rain on a large number of days, due frequently to thunderstorms. On the 5th the fall was *considerable* at three stations; on the 18th it was *considerable* at six, *very considerable* at three, and *heavy* at Weston Park (1·54 in.); on the 24th it was *considerable* at one station; on the 25th it was *considerable* at two stations and *very considerable* at two; on the 26th it was *considerable* at four; on the 30th at five; and on the 31st at four. The 5th was the wettest day at two stations, the 8th at one station, the 11th at one, the 18th at ten stations, the 19th

at one station, the 20th at one, the 24th at two stations, the 25th at seven, the 26th at three, the 30th at ten, the 31st at three, and the 18th and 25th were the wettest at one station. The rainfall on the 5th was due to a thunderstorm which was especially violent at Royston. The rain fell so heavily as to flood the streets and find its way from them into the houses, and large hailstones fell, smashing glass in greenhouses. On the 31st there was a thunderstorm with heavy rain and hail, especially severe at St. Albans.

September.—About the average amount of rain fell on about the usual number of days, and, as in August, the heavier falls were due to thunderstorms. On the 1st the fall was *considerable* at ten stations, on the 2nd at six, and on the 5th at three; on the 29th it was *considerable* at eight stations, *very considerable* at nine, *great* at Royston and Odsey (1·13 in.), Throcking Rectory (1·15 in.), Weston Park (1·19 in.), and Southgate (1·21 in.). The 1st was the wettest day at twelve stations, the 2nd at two, and the 29th at twenty-eight. On the evening of this day a severe thunderstorm passed over the County. Trees were struck by the lightning and the Lea valley was flooded with the rain.

October.—A very dry month, with rain on a small number of days, the fall being between one-third and one-fourth the average and on three-fourths the usual number of days. There was no *considerable* fall of rain. The 2nd was the wettest day at four stations, the 3rd at one station, the 18th at thirty-three stations, the 25th at three, and the 2nd and 18th were the wettest at one station.

November.—Another very dry month, with rain on a small number of days, the fall being between one-half and one-third the average and on three-fourths the usual number of days. As in October, there was no *considerable* fall of rain. The 8th was the wettest day at four stations, the 27th at twenty-eight, the 28th at eight, the 8th and 27th were the wettest at one station, and the 27th and 30th at seven stations.

December.—Very wet, with rain on more than the usual number of days. On the 1st the fall was *considerable* at one station (Much Hadham); on the 7th it was *considerable* at eighteen stations and *very considerable* at eight; and on the 29th it was *considerable* at fourteen and *very considerable* at three. The 1st was the wettest day at two stations, the 7th at thirty-three, and the 29th at seven.

APPENDIX.

The Floods of February. — The thawing of the snow which fell towards the end of January, and the heavy rains of the first week in February, falling on ground already saturated or perhaps in some places still frozen, caused serious floods over the south of England and especially in the Thames Basin. Hertfordshire suffered severely, the Colne and the Lea, and some of their tributaries, overflowing their banks. The floods commenced on

Friday the 5th, were at their height on the following day, and in most places were subsiding on the Sunday, but much land continued under water for the whole of the week.

The Colne is frequently dry in the upper part of its course, but in February the meadows at Potterells near North Mimms, in which are most of the "swallow-holes" which usually absorb any water flowing towards them, were converted into a lake which received the upper waters of the Colne, and, overflowing, passed them on down the usually dry river-bed in a rapidly flowing stream of large volume. Waterend Lane was inundated, and the road at the entrance to the avenue leading to the Church was several feet under water, so also were Dellsome, Marshmoor, and Bell Bar lanes, and many of the roads in the neighbourhood of Colney Heath, Smallford, and London Colney. At Park Street the low-lying land was only a few inches under water, but there were several feet of water on the land by the river near Watford, and the roads there were impassable. Even Watford itself was flooded, the lower part of High Street being completely under water, and the Urban Council provided carts to convey pedestrians. Below Watford the land by the Colne was flooded to beyond Rickmansworth, where the river leaves our county.

The Lea overflowed its banks both above and below Wheathampstead, the meadows on both sides of the river near the village being submerged and the roads rendered impassable where the river is crossed by foot-bridges. In the neighbourhood of Roestock, between St. Albans and Hatfield, the fields were covered with water and the main roads were also submerged. Hatfield did not suffer much, but the Lea overflowed its banks at Mill Green, just below this town, and inundated the roads, and on Sunday the 7th the mill wheel was allowed to run in order to admit of a greater volume of water passing down the river. At Hertford a great part of Hartham was flooded and the Meads were largely under water. Ware suffered severely, and at Stanstead the water flowed from the streets into the houses. At Broxbourne the river developed into a broad expanse of water, the towing-path was invisible, and the water washed the walls of the Crown Hotel.

Of the tributaries of the Lea, the Mimram deluged the meadows about Welwyn, the Beane covered the low-lying land between Clapton and Hertford with water, and the upper waters of the Stort overflowed and submerged the surrounding country down to its junction with the Lea, covering the roadway at Bishop's Stortford with two feet of water.

This is the highest flood experienced in Hertfordshire since 1881, and it is said to be the highest at Hertford since 1878.

Floods again occurred early in March, in the valleys of both the Lea and Colne, but were not nearly so severe as in February.

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VOL. X. PART 2.

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IV.

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1897.

80032

By Alan F. Crossman, F.L.S.

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Read at Watford, 26th April, 1898.

I am able this year to add two birds to our list of the Birds of Hertfordshire, and also to add a bird to our breeding species, which, although it has occurred on one occasion in the county, has never before to my knowledge nested here. Of the two birds new to our list one is a bird which has long since been extinct in this country as a breeding species, and which now, alas! is only an occasional winter visitor. The bird I refer to is the great bustard, which I have no doubt whatever formerly nested in Hertfordshire. The other bird is the Dartford warbler, which is a species one might expect to find in a county which abounds in furze-covered commons, haunts which this bird loves. With regard to the species which in 1897 nested for the first time in Herts, some difference of opinion may arise as to whether it should be admitted to our register. This bird is the little owl. I think, however, that such facts as I shall bring forward when discussing this bird at length will show that it should be so admitted.

The year 1897 was not remarkable for the occurrence of any very uncommon birds in Herts, with one exception, which I shall mention later, but nevertheless it may, I think, be considered a fairly good one from the ornithologist's point of view. Several species of birds which some few years ago were apparently considered rare in this county can at the present time be put down as regular visitors, and though on the one hand some birds—for example, the stone-curlew—are decidedly decreasing, others such as the hawfinch, wood-wren, and woodpeckers are most certainly in some parts increasing as breeding species. The exception I referred to above is the crane, a specimen of which was shot in Hertfordshire in the spring of 1897. I have seen the remains of this bird, but until I can obtain further particulars about it I do not propose to mention it more fully in my report.

The following birds are new to the county list.

1. Dartford Warbler (*Silvia undata*).—The Dartford warbler has never previously been recorded in Hertfordshire, although Mr. Harting so long ago as 1866 stated that it had occurred on Stanmore Common, which is almost on the borders of this county. No doubt it has actually occurred here, although till now it has not been recognized. It will in time probably be found to be a resident, inasmuch as the county abounds in furze-covered commons, to which this bird is extremely partial. The case I have now to record is the identification by Mr. Charles Worte of a pair of Dartford warblers on Common Wood Common, near

Chipperfield, on May 1st of last year. These birds, from their behaviour, were apparently nesting there. Mr. Worte, who is well acquainted with this species, has no doubt whatever about the identity of the birds he saw. Colonel Irby, in his 'Key List of British Birds,' speaks of this species as being resident south of the Thames, but rarely occurring north of that river. He also states that it is local, being found in gorse districts only. Mr. Howard Saunders, in the second edition of his 'Manual of British Birds,' which is now in course of publication, says: "Allowing for a little wandering it may be described as a resident species in the south, chiefly frequenting furze-covered commons, and apparently extending its range both westward and northward of late years. It is a skulking little bird, especially in dull rainy weather, and a patch of gorse holding two or three pairs may be easily passed over, even by a careful observer, as untenanted."

2. Great Bustard (*Otis tarda*). — In my report for 1895 I stated that I thought that this bird should be included in our county list, but that I could find no specific record of it in Hertfordshire. Since then I have been able to obtain some more information, which, although not very definite, is sufficient to justify the great bustard being included in the birds of Hertfordshire. As the country around Royston appeared to me to be the most likely place for it to have remained in, I made inquiries of Mr. Nunn of that place. He could not tell me very much, but he was able to inform me that about ninety years ago the last Hertfordshire specimen appeared in the neighbourhood of Royston. Many people went out to try and shoot the bird, but nobody was successful, and it eventually disappeared. There is one more record of this splendid bird in our county: this is a statement by Willoughby and Ray that the great bustard frequented Royston Heath. No doubt at one time this bird was not uncommon on the vast open fields which extended across the north of Hertfordshire. Though I can at present give no more details, this short account may perhaps be interesting, inasmuch as it goes towards showing that our county was once one of the haunts of the finest bird indigenous to the British Isles. If any of our members should wish to read more about the occurrence of the bird in England, I would refer them to Stevenson's 'Birds of Norfolk,' in which is collected a detailed history of the Norfolk bustards, the last survivors of the race resident in Britain. The great bustard has occurred in this country on several occasions since the extermination of the Norfolk birds, but one does not place migrants on a level with birds which were natives of the soil.

I will now give the notes that I have obtained on various birds which have occurred before in the county but appear to me to be worthy of record.

Blackbird (*Turdus merula*).—Mr. T. Vaughan Roberts informs me of a pied variety of this bird which frequented his garden last year. The white showed chiefly on the wings, but the head, back, and neck were also spotted.

Ring-Ouzel (*Turdus torquatus*).—A bird of this species was shot in the neighbourhood of Hitchin in August and was preserved. In my report for 1896 I reviewed the various records of the occurrence of this bird in Hertfordshire, and to that I would refer anyone desiring further information about the ring-ouzel in this county.

Robin (*Erithacus rubecula*). — Miss Ada Warner states that a white robin was constantly seen about her garden in 1897. It was evenly marked, having a white breast, red throat, and white back, while the rest of the body was normal in colour. She also informs me that a pair of robins built their nest in the box of an old breeding-cage hanging outside an outhouse, and brought up their brood successfully.

Bearded Tit (*Panurus biarmicus*).—Mr. Miller Christy, in his book on the 'Birds of Essex,' states that on the 12th of July, 1888, Mr. E. Taylor saw a male of this species in a large reed patch on the Herts side of the River Stort near Bishop's Stortford. Mr. Taylor got within a dozen yards of the bird and was able clearly to distinguish the long tail and black moustache. This bird has occurred on two previous occasions in the county, both of which are recorded in the 'Zoologist' for 1849. The late Rev. James Williams, of Tring Park, stated that a pair of these birds were shot on the Tring Reservoirs on the 21st of December, 1848; and Mr. Lucas, of Hitchin, recorded the occurrence of a small flock in a reed bed on the banks of the Oughton near that town. These birds were most probably migrants from the reed beds of the Eastern Counties, which always seem to have been the headquarters of this species in the British Isles. The drainage of meres and fens, aided somewhat by the greed of collectors, has done much to diminish the numbers of this bird, and Norfolk is now the only county in which it is to be found in any numbers, although it may occur to a very limited extent in one or two other localities.

Meadow-Pipit (*Anthus pratensis*).—Mr. Lucas informs me that he has found the nest of this bird on Oughton Head Common, and that he has also heard of it nesting at Ickleford. In my report for 1896 I stated that the only place in Hertfordshire where the fact of the meadow-pipit nesting was thoroughly authenticated was Royston. I am now able to add these two places, which are both in the locality of Hitchin.

Pied Flycatcher (*Muscicapa atricapilla*).—Mr. Lucas informs me that the specimen shot in Hitchin in the summer of 1896 was not preserved, owing to its being too badly damaged by the shot. It was, however, carefully identified. On the 23rd of April I saw a fine male of this species near Water End, Great Gaddesden, and watched it for some time. It uttered a call-note something like that of a tree-pipit (*Anthus trivialis*), and kept on flying off the branch or rail on which it happened to be sitting and catching insects. Although the pied flycatcher has only been recorded in Hertfordshire on five occasions, it is probable that it occurs in the county annually on its migration.

Hawfinch (*Coccothraustes vulgaris*).—The hawfinch was decidedly plentiful in the neighbourhood of Berkhamsted in 1897. I seldom went out without seeing one or more of them. I also saw it in April at Cokenach, near Royston. Mr. Lucas tells me that he heard of two instances of this bird nesting at Ippolytts, near Hitchin; and Mr. A. W. Dickinson, of New Farm, St. Albans, states that for the last three years hawfinches have frequently come to feed under the cherry-trees at that place.

Goldfinch (*Carduelis elegans*).—Mr. Lucas tells me that he saw a pair of these birds on Oughton Head Common on several occasions in 1897. Mr. H. S. Rivers, in March, saw a pair of goldfinches in his garden at Sawbridgeworth, and on May 29th found a nest with three eggs in an apple-tree there. The birds finally disappeared from the locality on September 19th. Mr. A. W. Dickinson informs me that he saw some of these birds on Bernard's Heath in October last. He thinks that steps should be taken to secure a close time for goldfinches all the year round for a time, as at the rate birdcatchers now take them these birds stand a fair chance of being exterminated. This would possibly be a good plan and might do something towards helping these beautiful birds, but it is not only the birdcatchers that are causing a decrease in their numbers. Goldfinches are always more plentiful in a badly cultivated country, where there are plenty of thistles and other plants of a similar nature, and one would hardly wish that Hertfordshire should be left uncultivated in order that various sorts of birds which have vanished or are vanishing from the county fauna should be restored to it. However much one may love birds, it might as well be suggested that the water should be let into the Fen country again in order that the former denizens of the Fens might once more nest there. Although much harm may have been done by birdcatching and collecting, neither of these causes can be compared with agriculture for having decreased our fauna. One must, however, remember that although certain birds which were abundant in former times have disappeared, on the other hand we have now many sorts which in those days were scarcely known here at all.

Siskin (*Chrysomitris spinus*).—Mr. Rivers saw ten of these birds at Sawbridgeworth on the 9th of March. They were on an elm-tree, and were busily feeding about the flowers. Although I seldom receive reports of the occurrence of the siskin in Hertfordshire, no doubt it occurs regularly every winter in varying numbers.

Brambling (*Fringilla montifringilla*).—About the middle of December I saw every morning thousands of these birds passing in a southerly direction over Berkhamsted. They commenced passing in immense flocks, and then small parties kept on going for the space of about half-an-hour. These birds were most probably roosting in some wood in the neighbourhood, and every morning went out to feed under the beech-trees round Berkhamsted. In 1895 I saw a vast concourse of these birds on several occasions in Ashridge Park.

Lesser Redpoll (*Linota rufescens*).—On the 23rd of March Mr. Rivers saw a bird of this species at Sawbridgeworth. The remarks I made above about the occurrence of the siskin apply also to this bird.

Crossbill (*Loxia curvirostra*). — I saw crossbills on several occasions in Ockridge Wood, near Berkhamsted, from the middle of September till the end of the year. They occur in this wood every year, and it is quite possible that a pair or two may remain there to nest, although up to the present I have not been able to prove that such is the case.

Little Owl (*Athene noctua*). — I have been informed that this bird nested in Hertfordshire in 1897 and hatched two young ones, one of which was killed by falling out of the nest. My informant, who is a reliable authority, asked me to withhold his name and the locality, lest some enterprising collector should go to the place and disturb the birds, which are still there. Many of these small owls have been turned down at various times and have spread over the country, and are now found nesting in several districts, but I think nevertheless that this bird should be admitted to our county list for the same reason that the red-legged partridge and certain other recognized British birds are admitted, viz., that they are now thoroughly established in this country; moreover, the species now under discussion has, I believe, occurred over here in the actual wild state. The only other record of this bird in Hertfordshire is of one shot near Ashwell in May, 1877. The late Lord Lilford did much towards establishing the species in Northamptonshire, as he turned down large numbers of them in that county. In his book on the 'Birds of Northamptonshire' he states that this species is more or less common throughout Europe to the south of the Baltic, and is very numerous in Holland, from which country all his birds were originally obtained.

Hen-Harrier (*Circus cyaneus*). — Mr. E. P. Thompson, of Elstree, informs me that Mrs. Brightwen's bailiff at the reservoir there saw a hawk on November 7th, which he is quite certain was of this species. Mr. Lucas also tells me of a stuffed specimen of the hen-harrier in the possession of Mr. Goddard, of Hitchin, who shot it on Oughton Head Common some years ago. In 1883 Mr. M. R. Pryor observed one of these birds at Weston Manor, near Stevenage, as was mentioned by the late Mr. Littleboy in his report for that year. This is another bird which, though at one time fairly plentiful in the British Isles, is gradually disappearing on account of the changing aspect of the country, and the immense amount of game-preserving that prevails now.

Common Buzzard (*Buteo vulgaris*).—Mr. Joseph Nunn informs me that a fine common buzzard was shot at Barrington about September or October. This is very probably the bird referred to in 'The Globe' of 9th September, 1897, as having been shot in Hertfordshire and presented to the St. Albans Museum. I have not at present obtained any further particulars about this bird, but hope that some of the members of this Society may be able to assist

me. The common buzzard has only been recorded in Hertfordshire on very few occasions, although most probably in former times it was a resident in the county, together with such birds as the kite and raven, which are now also no longer found here.

Peregrine Falcon (*Falco peregrinus*).—On September 30th a female peregrine was shot by Mr. W. Brown, of Newnham, Baldock. It weighed 4 lbs., and measured 43 inches from tip to tip of the wings. The bird was preserved by Mr. J. S. Wright, of Clifton, Beds, and is now in the possession of Mr. Brown. On December 16th a peregrine was seen in the neighbourhood of Elstree, and Mr. E. P. Thompson informs me that it remained there some days. The peregrine falcon occurs in Hertfordshire nearly every year during the autumn, but unfortunately it is nearly always killed.

Glossy Ibis (*Falcinellus igneus*).—In November, 1887, a specimen of this bird was shot about 200 yards from the village of Waterford by Mr. J. Roberts. It was stuffed by Mr. Shrimpton, of Hertford, and passed into the hands of Mr. W. P. Westall, who sold it to the Hon. Walter Rothschild. This bird is, I believe, now in the Tring Museum. The bird has been obtained in Hertfordshire on one other occasion, one having been shot by Mr. Pantia Ralli, in Ball's Park, on 10th September, 1881.

Sheldrake (*Tadorna cornuta*).—Street saw a sheldrake at the Tring Reservoirs on January 10th. In my report for 1896 I mentioned the various occurrences of this duck in Hertfordshire.

Pintail (*Dafila acuta*).—Mr. Lucas informs me that a specimen of this duck was shot at Radwell, near Hitchin, by Mr. Hilton in 1877, and was preserved.

Teal (*Querquedula crecca*).—Mr. Lucas has often seen teal at Oughton Head, near Hitchin, but has not been able to ascertain whether they nest there. The late Mr. J. E. Littleboy recorded the nesting of this species at Tring, the nest being sent to the South Kensington Museum.

Wigeon (*Mareca penelope*).—Street shot a wigeon at Tring on February 9th, and another which was preserved was obtained near Hitchin during the year.

Stone-Curlew (*Œdicnemus scolopax*).—Mr. Lucas reports that he heard this bird near Hitchin during the summer of 1897. I am pleased to be able to record this, as the stone-curlew, although formerly a fairly plentiful breeding species, is now a very rare bird in Hertfordshire.

Golden Plover (*Charadrius pluvialis*).—This bird appeared in large numbers in various parts of the county in December. Street informs me that he saw considerably over a hundred together on one occasion at the Tring Reservoirs during that month.

Oyster-Catcher (*Hæmatopus ostralegus*).—Street shot an oyster-catcher at one of the Reservoirs on September 24th. This bird has been obtained on one occasion at Elstree Reservoir, where Mr. Wilshin shot one in February, 1868. These, so far as I can

at present ascertain, are the only recorded occurrences of this species in Hertfordshire.

Great Snipe (*Gallinago major*).—A bird of this species was shot at Slip End, in the parish of Sandon, by Mr. J. H. Phillips, of Royston, on September 11th. It was a female, and was sent to Mr. Burton, of Wardour Street, for preservation. The bird is now in the possession of Mr. Phillips. In the report for 1896, I stated that this bird had been recorded in Herts on two occasions. Mr. Howard Saunders, in his 'Manual of British Birds,' says that "the adult may be distinguished from the common snipe by its larger size, proportionately shorter legs and bill, more boldly barred underparts, and especially by the very much greater amount of white in the tail feathers, which are normally sixteen (exceptionally eighteen in the moult) and not fourteen in number. In the young bird the tail feathers are barred across both webs, but their ground colour is of a pure white or buff, and not mottled, as in the common snipe."

Dunlin (*Tringa alpina*).—Nine of these birds were seen at the Reservoirs on June 5th, while a bird of the season was shot at Mordan about the beginning of July.

Green Sandpiper (*Totanus ochropus*).—Four green sandpipers were seen at Tring by Street on May 12th. This is a bird which occurs regularly in Hertfordshire on migration.

Redshank (*Totanus calidris*).—Street reports the occurrence of four redshanks at Tring on May 18th. This bird very rarely occurs in this county, although one would expect it occasionally at the Tring Reservoirs.

Greenshank (*Totanus canescens*).—This bird occurred at the Reservoirs in May, three being seen there on the 13th of that month.

Curlew (*Numenius arquatus*).—Mr. E. P. Thompson informs me that some of these birds were seen at Elstree in July. On October 16th Street saw sixteen curlews at the Tring Reservoirs. These birds apparently appear in Hertfordshire annually on migration.

Black Tern (*Hydrochelidon nigra*).—On May 9th Street saw between seventy and eighty of these birds at the Reservoirs, and on June 10th he saw three. This species is also a regular visitor on migration.

Common Tern (*Sterna fluviatilis*).—A large party of common terns were seen at the Reservoirs by Street on May 13th. This species usually occurs there in considerable numbers during the month of May.

Lesser Tern (*Sterna minuta*).—Street reports that six birds of this species appeared at the Reservoirs on May 14th. This makes the third year in succession in which I have been able to record the occurrence of this tern at Tring.

Common Gull (*Larus canus*).—In 1896 this bird occurred frequently at the Reservoirs, but last year Street only saw the species on one occasion, viz., six on September 4th.

Herring-Gull (*Larus argentatus*).—Eight of these gulls appeared at the Reservoirs on September 16th. Mr. M. R. Pryor informs me that flights of gulls, some of which were probably of this species, passed over Weston Manor at intervals from the beginning of September to the end of November. They were generally flying nearly due south, and usually went over just before sunset. I saw an immature specimen of this bird stuffed in the head-keeper's cottage at Ashlyns, near Berkhamsted; the owner informed me that he had shot it about a year and a half ago in that neighbourhood.

Great Black-backed Gull (*Larus marinus*).—Four of these gulls were seen at Tring on September 9th. These birds occur there at intervals, as also does the lesser black-backed gull. Some of the gulls seen by Mr. Prior passing over Weston Manor were apparently of the black-backed species.

Kittiwake (*Rissa tridactyla*).—Mr. Lucas tells me that a kittiwake was picked up in the Priory Garden, Hitchin, in January, and was preserved by Stratton, of that town. This gull has only been recorded in Hertfordshire on about four other occasions, the last being a bird seen by me flying over Berkhamsted Common.

Great Northern Diver (*Colymbus glacialis*).—Street informs me that a great northern diver appeared at the Reservoirs on January 12th, but does not mention whether it was obtained. There is always the chance with these birds of wrong identification, unless they are actually procured, and therefore, although Street is a most accurate observer, I must put a query against this record. I mentioned in my report for 1896 the various occurrences of this bird in Hertfordshire.

This completes my notes on various birds which occurred in Hertfordshire in 1897, and I now give the annual table of the arrival and departure of the summer and winter migrants.

Arrival and Departure of Migrants.

Summer Migrants.

Species.	Locality.	Date.	Observer.
Wheatear	Tring Reservoirs	Mar. 24	J. Street.
(*Saxicola œnanthe*)	Berkhamsted	,, 28	A. F. C.
(Last seen)	Sawbridgeworth	Sept. 6	H. S. Rivers.
Redstart	Sawbridgeworth	April 15	H. S. Rivers.
(*Ruticilla phœnicurus*)	Water End, near Berkhamsted	,, 23	A. F. C.
(Last seen)	Berkhamsted	Sept. 12	A. F. C.
Nightingale	Sawbridgeworth	April 11	H. S. Rivers.
(*Daulias luscinia*)	Hitchin	,, 15	J. E. Little.
	St. Albans	,, 16	H. Lewis.
	Odsey	,, 18	H. G. Fordham.
	Tring	,, 18	J. Street.
	Watford	,, 18	C. Worte.
	Berkhamsted	,, 20	W. B. Hopkins.
	Boxmoor	,, 21	A. F. C.
	Harpenden	May 1	J. J. Willis.

Species.	Locality.	Date.	Observer.
Common Whitethroat	Sawbridgeworth	April 22	H. S. Rivers.
(*Silvia cinerea*)	Watford	,, 25	C. Worte.
	Berkhamsted	,, 29	A. F. C.
Lesser Whitethroat	Tring	,, 16	J. Street.
(*Silvia curruca*)	Sawbridgeworth	,, 26	H. S. Rivers.
	Great Gaddesden	,, 28	A. F. C.
	Berkhamsted	,, 29	A. F. C.
Blackcap	Sawbridgeworth	May 9	H. S. Rivers.
(*Silvia atricapilla*)	Cokenach, near Royston	,, 24	A. F. C.
Garden-Warbler	Watford	,, 2	C. Worte.
(*Silvia hortensis*)	Sawbridgeworth	,, 19	H. S. Rivers.
	St. Albans	,, 20	H. Lewis.
Chiffchaff	Berkhamsted	Mar. 21	A. F. C.
(*Phylloscopus rufus*)	Radlett	,, 24	Miss Lubbock.
	Sawbridgeworth	,, 24	H. S. Rivers.
	New Farm, St. Albans	April 2	A. W. Dickinson.
	Tring	,, 14	J. Street.
(Last seen)	Berkhamsted	Sept. 21	A. F. C.
	Sawbridgeworth	,, 24	H. S. Rivers.
Willow-Wren	New Farm, St Albans	April 5	A. W. Dickinson.
(*Phylloscopus trochilus*)	Champneys, near Berkhamsted	,, 11	Arthur Crossman.
	Radlett	,, 11	Miss Lubbock.
	Sawbridgeworth	,, 11	H. S. Rivers.
	St. Albans	,, 15	H. Lewis.
(Last seen)	Berkhamsted	Sept. 12	A. F. C.
Wood-Wren	Berkhamsted	April 29	A. F. C.
(*Phylloscopus sibilatrix*)	Ashridge Park	May 2	A. F. C.
Reed-Warbler	Tring Reservoirs	April 18	J. Street.
(*Acrocephalus streperus*)	Watford	,, 30	C. Worte.
Sedge-Warbler	Tring Reservoirs	,, 18	J. Street.
(*Acrocephalus phragmitis*)	Sawbridgeworth	,, 18	H. S. Rivers.
	Watford	,, 24	C. Worte.
Grasshopper-Warbler	Berkhamsted	,, 22	A. F. C.
(*Locustella nævia*)			
Yellow Wagtail	Tring Reservoirs	,, 6	J. Street.
(*Motacilla Raii*)			
Tree-Pipit	Sawbridgeworth	,, 15	H. S. Rivers.
(*Anthus trivialis*)	St. Albans	,, 19	H. Lewis.
	Berkhamsted	,, 22	A. F. C.
Red-backed Shrike	Tring	May 13	J. Street.
(*Lanius collurio*)	Sawbridgeworth	,, 23	H. S. Rivers.
Pied Flycatcher	Water End, near Berkhamsted	April 23	A. F. C.
(*Muscicapa atricapilla*)			
Spotted Flycatcher	Odsey	May 2	H. G. Fordham.
(*Muscicapa grisola*)	Sawbridgeworth	,, 8	H. S. Rivers.
	New Farm, St. Albans	,, 12	A. W. Dickinson.
	Berkhamsted	,, 16	A. F. C.
	Watford	,, 26	Mrs. Bishop.
(Last seen)	Sawbridgeworth	Sept. 12	H. S. Rivers.
	Odsey	,, 21	H. G. Fordham.
Swallow	Berkhamsted	April 3	Mrs. Mawley.
(*Hirundo rustica*)	Bricket Wood	,, 10	A. F. C.
	Tring	,, 10	J. Street.
	St. Albans	,, 14	H. Lewis.
	Sawbridgeworth	,, 14	H. S. Rivers.
	Cokenach, near Royston	,, 16	Alex. Crossman.
	Watford	,, 17	C. Worte.

Species.		Locality.	Date.	Observer.
Swallow		Radlett	April 17	Miss Lubbock.
(*Hirundo rustica*)		Odsey	,, 18	H. G. Fordham.
		Harpenden	,, 24	J. J. Willis.
	(Last seen)	Watford	Oct. 4	Mrs. Bishop.
		Harpenden	,, 8	J. J. Willis.
		New Farm, St. Albans	,, 9	A. W. Dickinson.
		Sawbridgeworth	,, 10	H. S. Rivers.
		Berkhamsted	,, 16	A. F. C.
		Odsey	Oct. 16	H. G. Fordham.
House-Martin		Tring Reservoirs	April 10	J. Street.
(*Chelidon urbica*)		Watford	,, 22	C. Worte.
		Sawbridgeworth	,, 28	H. S. Rivers.
		Boxmoor	May 2	A. F. C.
	(Last seen)	Berkhamsted	Sept. 25	A. F. C.
		Sawbridgeworth	Oct. 17	H. S. Rivers.
Sand-Martin		Tring Reservoirs	Mar. 26	J. Street.
(*Cotile riparia*)		Watford	April 11	C. Worte.
		Sawbridgeworth	,, 19	H. S. Rivers.
Swift		Sawbridgeworth	,, 30	H. S. Rivers.
(*Cypselus apus*)		Boxmoor	May 1	A. F. C.
		Tring Reservoirs	,, 6	J. Street.
	(Last seen)	Berkhamsted	Aug. 18	A. F. C.
		Sawbridgeworth	Sept. 8	H. S. Rivers.
Nightjar		Batchwood, St. Albans	May 6	A. W. Dickinson.
(*Caprimulgus europæus*)				
Wryneck		Radlett	April 4	Miss Lubbock.
(*Iynx torquilla*)		St. Albans	,, 8	H. Lewis.
		Sawbridgeworth	,, 15	H. S. Rivers.
		Berkhamsted	,, 15	H. Kelham.
Cuckoo		New Farm, St. Albans	,, 16	A. W. Dickinson.
(*Cuculus canorus*)		Tring	,, 17	J. Street.
		Watford	,, 18	C. Worte.
		St. Albans	,, 18	H. Lewis.
		Berkhamsted	,, 19	Mrs. Mawley.
		Harpenden	,, 19	J. J. Willis.
		Elstree	,, 19	E. P. Thompson.
		Hitchin	,, 20	J. E. Little.
		Odsey	,, 20	H. G. Fordham.
		Radlett	,, 20	Miss Lubbock.
		Sawbridgeworth	,, 21	H. S. Rivers.
Turtle-Dove		Watford	May 1	C. Worte.
(*Turtur communis*)		Berkhamsted	,, 1	A. F. C.
		Tring	,, 6	J. Street.
		New Farm, St. Albans	,, 11	A. W. Dickinson.
		Sawbridgeworth	,, 22	H. S. Rivers.
	(Last seen)	Sawbridgeworth	Sept. 25	H. S. Rivers.
Landrail		Tring	April 18	J. Street.
(*Crex pratensis*)		Watford	,, 27	C. Worte.
		Sawbridgeworth	May 14	H. S. Rivers.
	(Last seen)	Sawbridgeworth	Sept. 25	H. S. Rivers.
Common Sandpiper		Sawbridgeworth	May 16	H. S. Rivers.
(*Totanus hypoleucus*)				

Winter Migrants.

Fieldfare	(Last seen)	Berkhamsted	Mar. 28	A. F. C.
(*Turdus pilaris*)		Sawbridgeworth	April 11	H. S. Rivers.
	(First seen)	New Farm, St. Albans	Oct. 25	A. W. Dickinson.
		Sawbridgeworth	,, 26	H. S. Rivers.
		Berkhamsted	Nov. 14	A. F. C.

Species.		Locality.	Date.	Observer.
Redwing ..... (*Turdus iliacus*)	(First seen)	Sawbridgeworth	Oct. 21	H. S. Rivers.
		Tring	,, 23	A. F. C.
		New Farm, St. Albans	Nov. 1	A. W. Dickinson.
Grey Wagtail (*Motacilla melanope*)	(Last seen)	Sawbridgeworth	Feb. 26	H. S. Rivers.
Hooded Crow (*Corvus cornix*)	(First seen)	Sawbridgeworth	Nov. 6	H. S. Rivers.

In conclusion, I must thank all who have so kindly supplied me with materials for this report by sending me notes on various birds, and I hope that in future years they will continue to do so. I might remind the members of this Society that I shall be glad to receive notes, not only on birds which have occurred in Hertfordshire during the year which my report especially comprises, but also on any birds which have not been previously recorded in our 'Transactions.'

V.

BRITISH PARASITIC FLOWERING PLANTS, WITH A LIST OF THE SPECIES.

By James Saunders.

Read at St. Albans, 8th December, 1897.

(Abridged.)

The Parasitic Flowering Plants of Britain, with their allies the Saprophytes, number 33 species and 6 sub-species or varieties, of which 23 species and 1 sub-species are known to occur in the South Midlands.

The true *Parasites* obtain either a part or the whole of their nourishment from the host plant to which they are attached. Of the British forms the mistletoe is the only species which is truly parasitic throughout its career, and it is distinguished also as being the only British shrub which belongs to this group. All the other parasites germinate in the soil, and, as the reserve material provided for their embryos is but small, the seedling must speedily attach itself to another plant, or it will perish. Hence the vast number of seeds which most of the species produce. Of these seeds only a small proportion germinate, and of those which do so a still smaller number succeed in attaching themselves to the plants necessary for their continued existence.

The subaërial and subterranean organs of chlorophyll-producing plants are subject to the attacks of these parasites. The broomrapes and the toothwort fasten themselves to the roots of their host, and the dodders adhere by suckers to the stems and foliage of such plants as are adapted for their sustenance.

Some parasites bear green leaves which are often small and not of a healthy hue. By these they obtain part of their food by assimilation from the atmosphere, and this is supplemented by that which can be derived from the plants to which they are attached. Examples of these are furnished by Bartsia, yellow rattle, and cow-wheat. Others again, after the seedling state, derive the whole of their food from the host plant, and in these cases the leaves which they bear, being diverted from their true functions, are reduced to scales, so that the parasite degenerates into a bundle of reproductive organs with the stems which are necessary to support the flowers and to convey nourishment to the parts which require it. Examples of these are furnished by the dodder, broomrape, and toothwort.

The *Saprophytes*, which are closely allied to the Parasites, and some of which were formerly regarded as belonging to them, obtain their nourishment from decayed vegetation. Their usual habitat is under trees where the accumulated leaves of many seasons have formed a considerable depth of loose soil. One genus at least, *Monotropa*, has no roots, being reduced to stem, leaf, scales, and

flowers, with their resultant seed-vessels. From the absence of roots it is assumed that it derives its nourishment, during its subterranean existence, by absorption through its whole surface, and at the proper season its flowering head is thrust above the soil. It is possible that it has the power of secreting from its surface a solvent which acts upon the surrounding humus and thus renders soluble the elements needed for its support, which can then be absorbed into its tissues. Analogies are furnished by the scutella of the embryos of Monocotyledons, so far as the chemical changes exerted upon its food are concerned, and by submerged aquatic plants in their power of absorbing through their whole surface.

Of this at least I am assured, that *Monotropa* has no roots, nor is it attached by suckers to any other living plant, so that it necessarily obtains its food by other means. Hundreds of plants have been extracted from the soil by myself and my friends, and although we have carefully delved down as low as possible, no trace of roots could be detected whenever the base of the stem has been reached.

To avoid any misapprehension it may be expedient to say that *Epiphytes* are properly outside our subject. They find lodgement only on their host, their food being obtained chiefly from the atmosphere, as in other green plants. They also derive a certain amount of moisture from the rain which trickles down from the branches above and is taken up by adventitious roots, as in ivy.

It often happens that epiphytal flowering plants occur on polled willows growing by the sides of streams. The seeds of these epiphytes have been carried to such positions either by the wind or by birds. The roots of these plants may sometimes be observed running down the inside of the hollow trunks of the willow and penetrating the soil at the base.

Those who wish to carry further the study of this subject may consult the following:—On parasitic flowering plants generally: 'Science Gossip,' 1885, pp. 157 and 172 (A. T. Webster); Sach's 'Text Book of Botany.' On the mistletoe: 'Science Gossip,' 1876 (W. G. P.), 1877 (Edwin Lees), and numerous references in the volumes for 1878, 1879, and 1880. From these sources the following list of trees on which mistletoe has been found in Great Britain has been compiled:—

Tiliaceæ.—Lime.
Sapindaceæ.—Maple, horse-chestnut (very rare).
Leguminosæ.—False acacia (*Robinia*).
Rosaceæ.—Hawthorn, pink hawthorn, crab-apple, orchard apple, pear (extremely rare).
Oleaceæ.—Elm (rare).
Cupuliferæ.—Oak (rare), hazel, filbert.
Salicineæ.—Black poplar, aspen, white willow.

In the following list of British parasitic and saprophytic flowering plants those which have been observed in Herts, Beds, and Bucks are specially indicated. It is noteworthy that there

are no British parasites or saprophytes in the large subdivisions Thalamifloræ and Calycifloræ.

PARASITES.

* Leaf-bearing Root-parasites.

Scrophulariaceæ.

Bartsia, L. Red eye-bright.

B. alpina, L. Sub-alpine. Rare.

Eufragia, Grisel. Marsh eye-bright.

E. viscosa, Benth. South England, Sussex to Cornwall.

Odontites, Moench.

O. rubra, Pers. Herts; Beds; Bucks.

Euphrasia, Tournef. Eye-bright.

E. officinalis, L. (For the aggregate) Herts; Beds; Bucks.

Rhinanthus, L. Yellow rattle.

R. Crista-galli, L. (*R. minor*, Ehrh., in Pryor's 'Flora Herts.') Herts; Beds; Bucks.
Sub-sp. *R. major*, Ehrh. Beds, in a cornfield at Harlington.

Pedicularis, Tournef.

P. palustris, L. Lousewort. Boggy places. Herts; Beds; Bucks.

P. silvatica, L. Red rattle. Wet heaths, etc. Herts; Beds; Bucks.

Melampyrum, Tournef. Cow-wheat.

M. pratense, L. (The aggregate) Copses, heaths, etc. Herts; Beds; Bucks.

M. silvaticum, L. Sub-alpine woods. Rare.

M. cristatum, L. Copses in the eastern counties. Rare. Herts; Beds.

M. arvense, L. Cornfields. Rare. Herts, one record only, Ashwell (*Fordham*), which Watson considered to require confirmation. (Fragment in hb. *Coleman*.)

** Leafless Root-parasites.

Orobancheæ.

Orobanche, L. Broomrape.

O. elatior, Sutt. (*O. major*, L., in Pryor's 'Flora Herts.') On *Centaurea scabiosa*, chiefly in the eastern counties. Rare. Herts.

O. major, Sm. *non* L. (*O. rapum*, Thuill, in Pryor's 'Flora Herts.') On roots of broom, etc. Herts; Beds; Bucks.
O. caryophyllacea, Sm. On Galiæ, Rubi, etc. South-eastern counties. Very rare.
O. rubra, Sm. On thyme. Chiefly on the west coast. Rare.
O. minor, Sutt. On roots of clover, etc. Herts; Beds; Bucks. The three following are probably varieties of this species:
O. Eryngii, Duby. On *Daucus gummifer*. South-west Coast and Channel Islands.
O. Picridis, F. W. Schultz. On *Picris*, etc. South-eastern counties, chiefly.
O. Hederæ, Duby. On ivy. South-western counties, chiefly.
O. cærulea, Vill. (*Philipæa cærulea*, C. A. Mey, in Pryor's 'Flora Herts.') On *Achillea millefolium*. Southern counties, chiefly. Herts, near Hoddesdon (*Coleman*).
Sub-sp. *O. arenaria*, Berk. Alderney.

Lathræa, L. Toothwort.

L. squamaria, L. Shady places, on roots of hazel, elm, etc. Herts; Beds; Bucks.

*** Leaf-bearing Parasites.

LORANTHACEÆ.

Viscum, L. Mistletoe.

V. album, L. On various trees. (See above, p. 45.) Herts, on lime, hawthorn, poplar, crab-apple, maple, white willow, aspen, apple-trees in orchards, hazel, and filbert; Beds, on hawthorn, maple, lime, and apple; Bucks.

SANTALACEÆ.

Thesium, L. Bastard toad-flax.

T. humifusum, DC. On various plants. Dry chalky pastures. Local. Herts, Sandon Heath, Royston Heath (*Fordham*); Beds (*Miss Twining*, Watson's specimen); Bucks (*Watson*, 'Top. Bot.').

**** Twining, leafless Parasites.

CONVOLVULACEÆ.

Cuscuta, Tournef. Dodder.

C. Epilinum, Weihe. Sporadic on flax. Herts; Beds, formerly, perhaps now extinct.
C. europæa, L. On nettles, etc. Herts; Beds; Bucks.
C. Epithymum, Murr. On thyme, ling, etc. Herts; Beds; Bucks.
C. Trifolii, Bab. On clover. Herts; Beds; Bucks.

SAPROPHYTES.

* Leaf-bearing Saprophytes.

Campanulaceæ.

Pyrola, Tournef. Winter-green.

P. rotundifolia, L. Moist woods. Rare. Northern counties, chiefly. Herts, Redheath, near Watford (*Pidcock*).
Var. *arenaria*, Koch. Lancashire sand-hills.
P. media, Sw. Woods and heaths. Chiefly in the northern counties.
P. minor, Sw. Woods and heaths. Herts; Beds; Bucks.
P. secunda, L. Mossy woods in mountainous districts. Northern counties, chiefly.
P. uniflora, L. (*Monensis grandiflora*, Salisb.) Chiefly in pine-woods.

** Leafless Saprophytes.

Campanulaceæ.

Monotropa, L. Bird's-nest.

M. Hypopithys, L. Woods, near fir and beech trees. Herts; Beds; Bucks.

Orchideæ.

Neottia, L. Bird's-nest orchis.

N. Nidus-avis, L. Dark woods, especially beech. Herts; Beds; Bucks.

Epipogum, Gmelin.

A. aphyllum, Sw. Amongst decayed leaves. Most rare (only once found). Tedstone Delamere, Herefordshire.

Corallorrhiza, Haller. Coral-root.

C. innata, R. Br. Boggy and sandy woods. East Scotland.

VI.

METEOROLOGICAL OBSERVATIONS TAKEN IN HERTFORDSHIRE IN THE YEAR 1897.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

Read at Watford, 26th April, 1898.

For some years three Meteorological Reports have annually been communicated to the Society and printed in the 'Transactions'—(1) on the rainfall, (2) on results of climatological observations, and (3) on meteorological observations at my own station, first at Watford and afterwards at St. Albans. Some portions of the latter have appeared in duplicate, having been included in the climatological reports. In order to avoid this in future I have determined to discontinue their publication as a separate paper, giving instead, in addition to the annual report on the rainfall, one general paper on meteorological observations taken chiefly at five stations in Hertfordshire.

The stations are the same as those from the records of which the climatology of the county has hitherto been deduced, namely, Royston, Bennington, Berkhamsted, St. Albans, and New Barnet; and for the sake of easy comparison with previous reports the results of climatological observations are given in a series of tables in the same form as before. There are also tables giving some other observations taken at the two most completely equipped observatories in the county, namely, Berkhamsted and Bennington. The observations for these stations are taken from 'The Meteorological Record' of the Royal Meteorological Society, and for Royston and New Barnet from the 'Meteorology of England,' which forms part of the Registrar General's 'Quarterly Report.'

At Berkhamsted, St. Albans, and Bennington, the thermometers for ascertaining the shade temperature are in Stevenson screens, the observations being taken in accordance with the regulations of the Royal Meteorological Society; at Royston and New Barnet they are under Glaisher screens. At Royston they have a little more protection from the sun's rays than is afforded by the ordinary Glaisher screen as used at New Barnet. The result of this is that only the observations taken at Berkhamsted, St. Albans, and Bennington can be strictly compared with each other so far as regards *range* of temperature, the greater range shown at Royston, and the still greater at New Barnet, being due to the more open exposure of the thermometers, which, in the Glaisher screens, are liable to be cooled below the temperature of the air by radiation at night, and heated above that of the air in the daytime. The rain-gauges at Royston, Berkhamsted, and New Barnet are 8 inches in diameter, and those at Bennington and St. Albans are 5 inches.

The much smaller number of days of rain at New Barnet than at the other places is chiefly (if not entirely) due to the method of

observation, amounts less than 0·01 in. and more than 0·005 in. being neglected here instead of being taken as 0·01 to compensate for falls of less than 0·005, which are rightly taken no account of.

The observations are taken at 9 a.m. at all the stations, and are entered to the day of observation, except the maximum temperature and the rainfall, which are entered to the previous day.

TABLE I.—*Results of Climatological Observations taken in Hertfordshire in the Year* 1897.

Stations	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Royston	49·8	41·7	57·9	16·2	21·0	88·3	83	6·6	22·59	167
Bennington	48·8	41·7	55·9	14·2	20·9	84·9	81	7·7	22·73	174
Berkhamsted	49·0	41·4	56·5	15·1	20·4	86·1	83	7·6	26·46	169
St. Albans	49·0	42·1	55·9	13·8	21·3	84·7	82	6·9	25·44	176
New Barnet	49·0	39·7	58·3	18·6	15·0	88·8	83	6·5	26·57	129
County	49·1	41·3	56·9	15·6	15·0	88·8	82	7·1	24·76	163

The year 1897 was warm. This is the only feature in which it differed materially on the whole from the average of the previous ten years. The mean temperature exceeded one degree of this average, the excess being a little more due to the mildness of the nights than it was to the warmth of the days. From this it follows that the range of temperature was rather less than usual. The amount of moisture in the air corresponding with its warmth (the relative humidity) was exactly the same as the average, but as the air was warm there was a little more moisture (absolute humidity) in it than usual. The sky was rather more cloudy than usual. The rainfall was about an inch and a half less than the average for the last half-century.

TABLE II.—*Means of Climatological Observations (with Extremes of Temperature) for the Seasons of* 1896–97.

Seasons	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Winter	38·1	33·4	42·8	9·4	19·5	60·0	91	8·3	8·68	56
Spring	46·8	38·4	55·2	16·8	20·0	76·2	78	6·7	6·60	42
Summer	61·6	51·4	71·9	20·5	34·0	88·8	76	6·4	6·29	32
Autumn	49·5	42·0	57·0	15·0	19·5	70·3	87	7·2	4·26	38

The winter of 1896–97 (December to February) was mild, owing almost entirely to the nights being warmer than usual, and therefore the mean daily range of temperature was small. The air was rather humid, the sky cloudy, the rainfall excessive, being nearly 80 per cent. above the average of the previous ten years, and the number of wet days was also great.

In the spring (March to May) the temperature was about the average, the nights were warmer and the days rather colder than usual, the daily range of temperature again being rather small. The air was of average humidity, the sky rather cloudy, the rainfall heavy, being 35 per cent. above the average, and there were rather more wet days than usual.

The summer (June to August) was warm, and, the excess of temperature being more due to the warmth of the days than to that of the nights, the daily range was great. The air was of about average humidity, the sky of average brightness, the rainfall rather small, and the number of wet days less than usual.

The autumn (September to November) was rather warm, owing chiefly to the warmth of the days, so that the daily range was again considerable. The air was of about average humidity, the sky rather cloudy, the rainfall very small, being 45 per cent. below the average, and there were fewer wet days than usual.

We thus had a mild and very wet winter, a wet spring of average temperature, a warm and rather dry summer, and a rather warm and very dry autumn. January, however, was rather cold, May was cold, August was very wet, and June and September were wet months. So also was December.

In the following notes on the months, Berkhamsted and St. Albans are most frequently alluded to merely because I have more information with regard to these places than I obtain from the other meteorological stations.

January.—A cold and rather humid month, more cloudy than usual, with much snow in the later half, which was much colder than the earlier half of the month, but with only an average rainfall (including snow), though the number of wet days was above the average. The low temperature was chiefly due to the coldness of the days, the daily range being less than usual. There was very little sunshine, more than half the days in the month being sunless. On Friday the 22nd there was one of the heaviest snowstorms which has occurred for some years, and, owing to the high wind in the night, many roads were blocked and rendered impassable. Railway communication on the Luton, Dunstable, and Leighton line was stopped for more than half the day by two immense snow-drifts. About Kensworth there were snow-drifts at least 15 feet deep. It is said to have been in some places in Hertfordshire the severest snowstorm which has been experienced since 1832. Mr. Mawley says that at Berkhamsted the snow was deeper on the morning of the 23rd than at any time since the 6th of January, 1887, measuring 7½ inches. The most noteworthy feature of this fall of snow, he says, was the dryness

and consequent lightness of the flakes, and he mentions, as showing what a great protection to low-growing vegetation such a fall of snow must prove, that on the nights of the 24th, 25th, and 26th the temperature was respectively 6, 9, and 11 degrees higher beneath the snow than immediately above it, the depth of snow on these nights being 4 inches.

February.—Unusually mild, rather humid, very cloudy, and with much rain, falling as snow during the first week. The frost broke up on the 4th, having lasted 19 days. The mean night temperature was 6 degrees above the average, the mean day temperature 4 degrees above it, the daily range thus being 2 degrees below the average. There was but little more sunshine than in January, half the days in the month being sunless. An account of the floods in the early part of the month has already been given in my report on the rainfall. (See p. 31.)

March.—Another warm month, with a rather dry atmosphere, an average amount of cloud, and an excessively heavy rainfall on an unusually large number of days. The excess of temperature was chiefly due to the mildness of the nights, as in February, though not to so great an extent. There were half as many more hours of bright sunshine than in January and February together. The rainfall was considerably more than double the average of the 50 years 1840–89, the excess being over two inches. With the heavy rainfall of Tuesday night, the 2nd, there was a severe gale, interrupting telegraphic communication on the following day, on which also floods again occurred. Between 1.30 and 2 p.m. on the 4th there was a sharp fall of hail, accompanied by thunder and lightning, and after the storm the ground was for a short time completely covered with hailstones. This is reported from Berkhamsted and St. Albans. The barometer showed the lowest pressure in the year on the preceding day, the reading at St. Albans at 9 a.m. on the 3rd being 28·688 inches. There was a gale of wind for a few hours after midday on the 18th and on the night of the 26th. Snow and hail fell on the 31st.

April.—Rather cold, with more than the average humidity, a cloudy sky, and about an average rainfall. The third month in succession with a small daily range of temperature, the nights being rather warmer than usual, but the days considerably colder. There was a little more bright sunshine than in March, but the record was a low one for April. The 26th to the 29th were very warm days, the maximum shade temperature at Berkhamsted and St. Albans exceeding 63° on each day, and at Berkhamsted 68° was reached on the 27th and 28th. At the latter place the black bulb solar-radiation thermometer, suspended four feet from the ground, rose to 125°, an unusually high reading for April, Mr. Mawley says. A little snow fell in the earlier part of the month. A thunderstorm occurred on the 16th in the north of the county.

May.—A cold month, with a dry atmosphere, a bright sky, and a rather small rainfall on a small number of days. Both the days

TABLE III.—*Means of Climatological Observations (with Extremes of Temperature) taken at Royston, Bennington, Berkhamsted, St. Albans, and New Barnet, during the Year* 1897.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·0	29·8	38·2	8·4	19·5	48·8	91	8·2	2·28	19
Feb.	42·1	36·9	47·2	10·3	21·0	60·0	89	8·8	2·57	14
March	44·4	37·4	51·3	13·9	21·0	63·3	82	6·7	3·69	19
April	45·2	37·0	53·4	16·4	20·0	68·8	79	7·6	1·58	13
May	50·7	40·7	60·8	20·1	26·0	76·2	72	5·7	1·33	10
June	59·9	50·1	69·8	19·7	40·3	88·8	80	7·4	2·53	11
July	62·7	51·8	73·6	21·8	34·0	83·0	71	5·6	·83	5
August	62·2	52·3	72·2	19·9	39·0	88·3	76	6·3	2·93	16
Sept.	54·6	46·4	62·9	16·5	34·5	70·3	84	6·9	2·56	13
Oct.	49·9	41·8	58·0	16·2	24·5	67·8	86	6·4	·76	12
Nov.	44·0	37·8	50·2	12·4	19·5	59·8	91	8·3	·94	12
Dec.	39·6	33·9	45·3	11·4	15·0	56·8	89	7·0	2·76	18
Year	49·1	41·3	56·9	15·6	15·0	88·8	82	7·1	24·76	163

TABLE IV. — *Climatological Observations taken at* LONDON ROAD, ROYSTON. *Latitude:* 52° 2′ 34″ N. *Longitude:* 0° 1′ 8″ W. *Altitude:* 301 *feet. Observer:* HALE WORTHAM, F.R.Met.Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·2	29·7	38·8	9·1	21·0	48·8	88	7·8	2·24	19
Feb.	41·9	36·7	47·2	10·4	28·3	60·0	85	8·3	2·33	14
March	44·9	37·7	52·1	14·4	25·2	63·3	82	6·8	3·55	19
April	45·9	37·2	54·6	17·4	27·9	68·6	79	6·7	1·44	13
May	51·6	40·9	62·3	21·4	31·3	72·3	75	5·5	1·05	10
June	61·6	50·7	72·6	21·9	41·0	85·1	82	7·0	2·14	10
July	63·8	52·2	75·4	23·2	42·7	83·0	79	5·4	·48	6
August	63·6	52·9	74·3	21·4	46·9	88·3	80	5·1	3·17	16
Sept.	55·2	46·7	63·7	17·0	36·2	70·3	83	6·1	2·80	13
Oct.	50·1	42·2	58·0	15·8	32·1	65·6	83	5·6	·69	16
Nov.	44·8	38·9	50·7	11·8	29·0	59·0	90	7·9	·88	14
Dec.	40·3	34·8	45·8	11·0	28·8	55·7	88	6·4	1·83	17
Year	49·8	41·7	57·9	16·2	21·0	88·3	83	6·6	22·59	167

and the nights were about two degrees colder than usual, there being an average daily range of temperature. There was more bright sunshine than in any month in the year but July, and there was not a single sunless day recorded at either Berkhamsted or Bennington. Hail fell on the night of the 10th; the exposed thermometer at Berkhamsted showed from four to five degrees of frost on the four nights 11th to 14th; and there was a slight fall of snow at Baldock on the 11th, at Odsey on the 12th, and at St. Albans on the morning of the 13th, but not sufficient there to yield a measurable quantity of water.

June.—Rather warm, very humid, cloudy, and with a considerable rainfall, but not many wet days. The excess of temperature was chiefly due to the nights being warm, the daily range being less than usual. Bright sunshine was unusually deficient for a summer month. There was a thunderstorm early on the morning of Tuesday the 1st, reported from Berkhamsted and St. Albans, and also from other places in the county, such as Royston and Rickmansworth. At Berkhamsted rain fell during the storm for five minutes at the rate of an inch an hour. About an inch of rain fell on the 8th. On the afternoon of Thursday the 24th there was a very severe hailstorm which did much damage between Hitchin and Luton, the loss to the crops in this district being estimated at several thousand pounds. Lilley Bottom, Pirton, and Henlow suffered most from its ravages. In many fields every head of corn was cut off by the hail. No hail fell at Hitchin, but at High Down, near Pirton, over 200 panes of glass were broken, and nearly all the windows in the village of Henlow. Many trees were blown down by the high wind, and the roofs of several cottages were stripped. The wind did most damage in the neighbourhood of Lilley Bottom and Henlow. Between 1.30 and 2 p.m., before this storm began to rage in the north-west of the county, there was a thunderstorm at St. Albans; and in the evening of the same day a very severe thunderstorm passed over St. Albans and other places. At King's Langley a terrific report was heard as a tree opposite Laurel Bank was struck by the lightning. At Kensworth the storm was severe, and a fine tree and the chimney of a cottage were struck. Rain fell at Berkhamsted during the storm for three minutes at the rate of nearly two inches an hour. This was the hottest day in the year at New Barnet, but at all other stations the 4th of August was the hottest. At Berkhamsted in the morning the heat in the sun's rays was very great, the black bulb solar-radiation thermometer registering 140°.

July.—A very warm month, with a very dry atmosphere, a very bright sky, and an exceedingly small rainfall on a small number of days. The nights were but little warmer than usual, but the days were very warm, the mean daily maximum temperature exceeding the average by more than three degrees. The mean daily range of temperature was the greatest of any month in the year. There was also more bright sunshine than in any other month in the year, and only one day was sunless. On the night of the 7th–8th

TABLE V. — *Climatological Observations taken at* BENNINGTON HOUSE, BENNINGTON. *Latitude:* 51° 53′ 45″ N. *Longitude:* 0° 5′ 20″ W. *Altitude:* 407 *feet. Observer:* REV. J. D. PARKER, LL.D., F.R.Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	33·7	29·8	37·5	7·7	22·1	47·2	94	8·2	2·13	19
Feb.	41·8	36·9	46·7	9·8	28·0	56·4	91	9·3	2·48	16
March	43·9	37·6	50·3	12·7	28·8	61·4	80	7·1	3·18	20
April	44·8	37·3	52·3	15·0	28·5	68·0	78	8·6	1·26	10
May	50·0	40·7	59·2	18·5	31·8	68·4	71	6·7	1·64	10
June	59·1	50·3	68·0	17·7	41·7	82·9	78	8·2	1·99	13
July	62·3	52·4	72·1	19·7	41·1	80·4	66	6·6	·62	5
August	61·9	52·9	71·0	18·1	47·2	84·9	73	6·8	2·52	16
Sept.	54·3	46·7	61·9	15·2	37·7	67·5	80	7·5	2·90	14
Oct.	50·3	43·4	57·2	13·8	34·6	64·8	86	7·1	·79	15
Nov.	43·9	38·3	49·5	11·2	28·0	57·9	91	8·9	·84	16
Dec.	39·8	34·5	45·0	10·5	20·9	55·4	89	7·5	2·38	20
Year	48·8	41·7	55·9	14·2	20·9	84·9	81	7·7	22·73	174

TABLE VI.—*Other Meteorological Observations taken at Bennington by the Rev. Dr. Parker.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	29·932	33·1	32·5	36·9	38·4	3	20	50	6·7	16
Feb.	30·128	40·5	39·4	39·8	39·8	0	21	61	8·8	13
March	29·712	43·3	40·7	42·9	43·0	4	14	152	11·2	2
April	·902	44·8	41·9	45·3	45·3	0	15	152	12·0	2
May	30·007	51·0	46·5	51·8	51·2	2	11	254	15·0	0
June	·052	60·0	56·3	59·3	58·0	3	19	188	15·1	5
July	·046	63·1	56·9	63·8	63·0	4	11	274	15·0	1
August	29·873	62·2	57·4	63·0	63·0	4	8	215	13·8	0
Sept.	30·028	54·8	51·8	56·1	56·8	2	16	144	10·8	1
Oct.	·210	49·4	47·5	51·1	52·6	6	13	126	8·8	2
Nov.	·224	43·3	42·2	46·1	47·6	1	19	50	7·2	14
Dec.	29·980	38·7	37·4	40·1	41·7	3	11	56	6·3	12
Year	30·008	48·7	45·9	49·7	50·0	32	178	1722	15·1	68

the exposed thermometer at Berkhamsted registered within a degree of the freezing-point. On the 18th the air was unusually dry. At St. Albans, at 1 p.m., the temperature of the air was 77°·8 and the temperature of evaporation 58°·8, showing a relative humidity of 32 per cent. By 3 p.m. this had increased about one per cent., the dry-bulb thermometer reading 80°·0, and the wet-bulb 61°·5. At about 5.30 p.m. on the 26th the tower of Christ Church, St. Albans, was struck by lightning in bright sunshine, and considerably damaged. There had been a thunderstorm, with hail and heavy rain, earlier in the afternoon. The rain was very heavy in some places; several streets in Hertford were flooded; at Southgate, East Barnet, 2·57 inches of rain fell.

August.—Another very warm month, being only half a degree colder than July, of average humidity and brightness, and with a heavy rainfall on a considerable number of days. Both the days and the nights were warm, but the excess of temperature was more due to the warmth of the days than of the nights, the daily range being therefore greater than usual. It was a sunny month, especially in the earlier half; no day was sunless. The 4th was the hottest day in the year at every station but New Barnet. On Thursday the 5th there was a very violent thunderstorm, reported as remarkable at Royston for the deluge of rain and the enormous hailstones which fell, the streets becoming running rivers and some of the houses in the lower part of the town being flooded. Glass in greenhouses also was smashed by the hail. At Tring a young man and woman sheltering from the storm under a tree at the Agricultural Show were killed by the lightning. During a thunderstorm on the 18th, reported from Berkhamsted and St. Albans, rain fell at the former place for eight minutes at the rate of an inch and a quarter an hour. The last day of the month was very stormy. During the morning heavy clouds rapidly drifted before a strong north-westerly wind, the sun shining between each cloud which passed across it; by midday the whole sky was overcast; and just after one p.m. a very severe storm broke over St. Albans, heavy rain and large hailstones falling and doing considerable damage to orchards and gardens. The Red Lion Hotel at Hatfield was struck by the lightning, a hole being made in the roof of the stables, a window being broken in, and a looking-glass and other articles smashed into pieces.

September.—About as much colder than the average as July and August were warmer, with a rather humid atmosphere and cloudy sky, and a considerable rainfall on an average number of days. The coldness was more due to the days than to the nights, the daily range of temperature being less than usual. There was a considerable decrease from August in bright sunshine, but only two or three days were sunless. The first ground-frost of the autumn occurred on the night of the 18th–19th, when the exposed thermometer at Berkhamsted registered one degree of frost. The night of the 23rd–24th was unusually warm, the exposed thermometer there not showing a lower temperature than 53°.

TABLE VII. — *Climatological Observations taken at* ROSEBANK, BERKHAMSTED. *Latitude :* 51° 45′ 40″ N. *Longitude :* 0° 33′ 30″ W. *Altitude :* 400 *feet. Observer :* EDWARD MAWLEY, Sec. R. Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·0	30·0	38·0	8·0	20·7	48·6	93	8·5	2·63	22
Feb.	42·1	37·4	46·8	9·4	25·5	56·9	91	9·7	2·87	14
March	44·4	37·8	50·9	13·1	25·5	63·3	83	7·1	4·08	20
April	45·1	37·3	53·0	15·7	26·1	68·4	79	7·7	1·68	16
May	50·5	40·8	60·2	19·4	31·9	70·0	69	6·6	1·19	11
June	59·5	50·1	68·8	18·7	40·6	82·2	78	8·0	2·77	12
July	62·3	51·8	72·9	21·1	39·1	80·3	68	5·7	·55	5
August	61·6	52·2	71·0	18·8	43·7	86·1	75	6·9	3·32	17
Sept.	54·5	46·5	62·5	16·0	36·9	67·3	83	7·3	2·05	13
Oct.	49·8	41·5	58·1	16·6	30·0	66·8	88	7·4	·86	9
Nov.	43·9	37·6	50·1	12·5	24·8	58·5	94	9·2	1·05	11
Dec.	39·9	34·3	45·5	11·2	20·4	56·1	91	7·5	3·41	19
Year	49·0	41·4	56·5	15·1	20·4	86·1	83	7·6	26·46	169

TABLE VIII. — *Other Meteorological Observations taken at Berkhamsted by Mr. Mawley.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	29·910	33·0	32·4	36·6	38·4	3	21	40	6·0	17
Feb.	30·109	40·6	39·5	40·2	40·0	0	22	40	6·7	16
March	29·683	42·9	40·7	43·8	44·0	5	10	119	9·8	3
April	·877	44·8	42·0	47·0	46·9	0	13	126	11·0	3
May	·993	51·3	46·4	53·8	53·2	3	7	239	13·7	0
June	30·040	60·1	56·3	61·6	59·9	2	15	165	14·8	4
July	·034	63·6	57·8	66·1	64·8	5	6	246	14·4	1
August	29·840	61·8	57·4	65·1	65·0	3	7	199	12·6	0
Sept.	30·017	54·0	51·4	57·1	58·2	2	13	128	9·6	3
Oct.	·203	48·1	46·5	51·7	53·5	3	9	114	9·2	1
Nov.	·207	43·0	42·2	46·2	48·2	1	20	41	5·8	15
Dec.	29·961	37·8	36·8	39·6	41·8	3	12	48	6·1	15
Year	29·990	48·4	45·8	50·7	51·2	30	155	1505	14·8	78

During the first week in the month there were several thunderstorms, with heavy rain, and there was a recurrence of thunderstorms at the end of the month. The most severe one was on Wednesday the 29th. At St. Albans between 8 and 10 p.m. more than half an inch of rain fell, and at Berkhamsted nearly half an inch. In some parts of the county the fall was more than double that at St. Albans, but the duration has not been reported. Much of the low-lying land in the Lea Valley was flooded, and roads about Hertford were submerged; near Hatfield a cyclist had his machine wrecked by the lightning, escaping uninjured himself; near Harpenden a tree was struck and thrown across the road just in front of two cyclists, who ran against it and were thrown off their machines; and at Bishop's Stortford a concert was interrupted for an hour by the incessant peals of thunder. Both on this day and the 2nd, stacks of corn were struck and set on fire.

October.—About as much warmer than the average as September was colder, with average humidity and cloud, but a very small rainfall on rather fewer days than usual. October is usually about nine degrees colder than September, but this year the fall in temperature from one month to the other was scarcely five degrees. The day temperature was mostly in excess of the average, the daily range being considerable. There was a very slight decrease from September in bright sunshine, and only one day was sunless. On the night of the 5th–6th the exposed thermometer at Berkhamsted showed five degrees of frost, on that of the 7th–8th the shade temperature sank to 30°, but on that of the 16th–17th only to 55°; the maximum shade temperature on the 17th was 67°, and on the 29th and 30th 63°; at St. Albans on each of these days it was one degree less. These are very high readings for so late in October. There was much fog at St. Albans during the last week in the month (25th to 31st).

November.—Another rather warm month, a little more humid than usual, very cloudy, but with a very small rainfall on rather fewer days than usual. The excess in temperature was almost entirely due to the days being warm, the daily range being considerable. There was an unusually small amount of bright sunshine, and half the days in the month were quite sunless. The last week was very stormy, and although the wind was frequently high, nearly every morning was foggy. At Berkhamsted during the 12 hours ending 6 a.m. on the 29th the wind blew at the mean velocity of 21 miles an hour, and between 6 and 7 at the rate of 25 miles; from the west.

December.—Unusually mild, with a rather dry atmosphere, an average amount of cloud, and a heavy rainfall on a large number of days. In the previous ten years the only other December with so high a temperature was that of 1894. The day temperatures were a little more above the average than the night temperatures, the daily range being rather greater than usual. Although the record of bright sunshine was again small, it was slightly higher than in November, and above the December average; nearly half

TABLE IX. — *Climatological Observations taken at* THE GRANGE, ST. ALBANS. *Latitude:* 51° 45′ 9″. *Longitude:* 0° 20′ 7″ W. *Altitude:* 380 *feet. Observer:* JOHN HOPKINSON, F.R.Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·0	30·4	37·5	7·1	22·2	44·9	92	8·1	2·30	20
Feb.	41·9	37·2	46·6	9·4	29·2	56·5	91	8·9	2·56	15
March	44·3	38·1	50·5	12·4	28·0	60·5	82	6·0	3·64	21
April	45·1	38·0	52·2	14·2	29·3	65·0	79	7·9	1·77	15
May	50·5	41·7	59·3	17·6	32·9	68·0	71	4·6	1·35	11
June.....	59·5	51·1	68·0	16·9	41·6	82·6	78	6·4	2·66	12
July	62·7	53·2	72·3	19·1	43·1	81·0	69	5·3	·60	6
August.....	62·0	53·4	70·6	17·2	47·6	84·7	73	7·0	2·89	17
Sept.....	54·4	47·1	61·7	14·6	37·3	67·5	83	6·6	2·45	16
Oct.	50·1	42·9	57·3	14·4	32·3	65·8	88	6·5	·86	11
Nov.....	43·8	37·8	49·8	12·0	28·0	57·5	93	8·5	·95	14
Dec.	39·4	33·8	45·1	11·3	21·3	54 9	89	6·9	3·41	18
Year	49·0	42·1	55·9	13·8	21·3	84·7	82	6·9	25·44	176

TABLE X. — *Climatological Observations taken at the* GAS WORKS, NEW BARNET. *Latitude:* 51° 39′ 5″ N. *Longitude:* 0° 10′ 15″ W. *Altitude:* 212 *feet. Observer:* T. H. MARTIN, Assoc M. Inst. C.E.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	34·2	29·2	39·3	10·1	19·5	48·0	89	8 2	2·11	14
Feb.	42·5	36·4	48·6	12·2	21·0	59·1	89	7·9	2·63	11
March	44·4	36·0	52·9	16·9	21·0	63·0	81	6·3	4·00	17
April	45·1	35·3	55·0	19·7	20·0	68 8	81	7·1	1·73	12
May	51·1	39·2	62 9	23·7	26·0	76·2	76	4·9	1·42	8
June.....	60·0	48·3	71·6	23·3	40·3	88·8	83	7·2	3·09	9
July	62·6	49·7	75 6	25·9	34·0	83·0	73	4 8	1·92	4
August.....	62·0	50·0	73·9	23·9	39·0	88·0	77	5·6	2·73	13
Sept.....	54·8	44·9	64·8	19·9	34·5	70·1	91	6·9	2·60	10
Oct.	49 0	38·7	59·3	20·6	24·5	67·8	86	5·6	·61	7
Nov.....	43·5	36·4	50·6	14·2	19·5	59·8	86	7·2	·99	7
Dec.	38 8	32·3	45·3	13·0	15·0	56·8	86	6·7	2·74	17
Year	49·0	39·7	58·3	18·6	15·0	88·8	83	6·5	26·57	129

the days in the month were sunless. A little snow fell during the first week, and on the 7th about three-quarters of an inch of rain, being the heaviest fall for six months. There was a westerly gale in the night, recorded at Berkhamsted and St. Albans, and also in the night of the 10th–11th at Berkhamsted, the mean velocity of the wind for an hour on each occasion reaching 20 miles. A thunderstorm is recorded from Rickmansworth shortly before one p.m. on Wednesday the 8th, with a heavy fall of sleet and rain; and on the following Wednesday (15th) there was one at Hertford, with heavy rain. Christmas Day was the coldest day in the month.

VII.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1897.

By Edward Mawley, Sec. R. Met. Soc., F.R.H.S.;
Phenological Recorder to the Royal Meteorological Society.

Read at Watford, 26th April, 1898.

No observations have been received from Hatfield, otherwise the list of observers remains the same as in the two previous reports. At the present time an observer is still much wanted in the neighbourhood of Bishop's Stortford in the east of the county, and another in the neighbourhood of Buntingford in the north-east, these localities being as yet altogether unrepresented.

In the following table will be found the list of observers, the districts they represent, and the approximate height of the stations above sea-level :—

Station.	Height above Sea-level.	Observer.
Watford (The Platts)	240 feet.	Mrs. G. E. Bishop.
Radlett (Newberries)	320 ,,	Miss E. M. Lubbock.
Broxbourne (Wormley)	120 ,,	A. Warner.
St. Albans (The Grange)	380 ,,	Mrs. J. Hopkinson.
St. Albans (Addiscombe Lodge)	400 ,,	Miss E. F. Smith.
St. Albans (Worley Road)	300 ,,	Henry Lewis.
Berkhamsted (Rosebank)	400 ,,	Mrs. E. Mawley.
Hertford	140 ,,	W. Graveson.
Harpenden	370 ,,	J. J. Willis.
Hitchin	230 ,,	J. E. Little, M.A.
Ashwell (Odsey)	260 ,,	H. G. Fordham.

The Winter of 1896–97.

Regarded as a whole, the winter of 1896–97 was about seasonable in temperature. There occurred, however, one cold period in January, lasting over a fortnight, when the thermometer exposed on the lawn indicated on each night from 4 to 21 degrees of frost. About the middle of this frost, snow fell at Berkhamsted to the depth of nearly eight inches. To give some idea as to the protection afforded to low-growing vegetation by such a covering, it may be mentioned that when this fall of snow had shrunk to four inches deep, a thermometer placed beneath it registered on one night 11 degrees less cold than a similar thermometer resting on its surface. In complete contrast to January, February proved a very mild winter month; indeed, the warmest February for eleven years.

A great deal of rain fell in December, and more than usual during February; but in January the rainfall (including melted snow) was light. The winter, besides being wet, was also

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1897, WITH THE MEAN DATE FOR 1876–1896.

SPECIES.	WATFORD.	ST. ALBANS.		RADLETT.	BERKHAMSTED.	HARPENDEN.	WORMLEY.	HERTFORD.	HITCHIN.	ASHWELL (Odsey).	MEAN, 1876–96.
		The Grange.	Addiscombe Lodge.								
Hazel (*Corylus avellana*)	Feb. 10	Feb. 6	Feb. 16	Feb. 25	Feb. 14	Feb. 15	Feb. 7	Jan. 7	Feb. 7	Feb. 7	Jan. 29
Coltsfoot (*Tussilago farfara*)	.....	.....	Feb. 23	.....	Feb. 17	Mar. 5	Feb. 18	Feb. 14	Feb. 19	Feb. 23	Feb. 26
Wood-Anemone (*Anemone nemorosa*)	.....	Mar. 27	Mar. 15	.....	Mar. 26	Mar. 20	.....	Mar. 7	Mar. 17	.....	Mar. 20
Blackthorn (*Prunus spinosa*)	Apl. 5	Apl. 4	Mar. 26	.....	Apl. 13	Mar. 28	.....	Mar. 21	Mar. 22	.....	Apl. 2
Garlic Hedge-Mustard (*Alliaria officinalis*)	Apl. 24	Apl. 7	Apl. 17	.....	Apl. 19	Apl. 15	.....	.....	Apl. 9	.....	Apl. 20
Horse-Chestnut (*Æsculus hippocastanum*)	May 8	May 2	Apl. 30	.....	May 10	May 15	.....	May 9	May 1	.....	May 9
Hawthorn (*Crataegus oxyacantha*)	May 18	May 8	May 14	.....	.....	May 10	.....	Apl. 30	Apl. 28	May 9	May 12
White Ox-Eye (*Leucanthemum vulgare*)	May 24	May 20	May 19	.....	May 21	May 27	.....	May 27	May 15	.....	May 20
Dog-Rose (*Rosa canina*)	June 3	May 28	.....	.....	.....	June 4	.....	May 31	.....	June 3	June 5
Black Knapweed (*Centaurea nigra*)	.....	June 21	.....	.....	June 26	.....	.....	June 20	.....	.....	June 21
Harebell (*Campanula rotundifolia*)	.....	July 1	.....	.....	July 12	July 16	.....	July 15	June 20	.....	July 5
Greater Bindweed (*Convolvulus sepium*)	.....	.....	Aug. 7	.....	July 3	July 18	.....	July 5	July 10	.....	July 8
Ivy (*Hedera helix*)	Sept. 27	Sept 5	.....	.....	Sept. 23	.....	.....	Sept. 19	Oct. 1	Sept. 16	Sept. 27

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1897, WITH THE MEAN DATE FOR 1876–1896.

SPECIES.	WATFORD.	ST. ALBANS.			RADLETT.	BERKHAMSTED.	HARPENDEN.	WORMLEY.	HITCHIN.	ASHWELL (Odsey).	MEAN, 1876-96.
		The Grange.	Addiscombe Lodge.	Worley Road.							
BIRDS.											
Song-Thrush (*Turdus musicus*)	.....	.....	Feb. 9	Jan. 3	.....	Jan. 2	Feb. 8	.....	.....	.....	Jan. 16
Swallow (*Hirundo rustica*)	Apl. 27	Apl. 24	.....	Apl. 14	Apl. 17	Apl. 3	Apl. 24	.....	.....	Apl. 18	Apl. 12
Cuckoo (*Cuculus canorus*)	Apl. 19	Apl. 24	Apl. 26	Apl. 18	Apl. 20	Apl. 19	Apl. 19	.....	Apl. 20	Apl. 20	Apl. 13
Nightingale (*Daulias luscinia*)	Apl. 29	Apl. 23	Apl. 19	Apl. 16	.....	Apl. 20	May 1	.....	Apl. 15	Apl. 18	Apl. 15
Spotted Flycatcher (*Muscicapa grisola*)	May 26	.....	.....	.....	.....	May 16	.....	.....	.....	May 2	.....
Swallow (last seen) (*Hirundo rustica*)	Oct. 4	.....	.....	.....	.....	Oct. 16	Oct. 8	.....	.....	Oct. 16	.....
INSECTS.											
Honey-Bee (*Apis mellifica*)	.....	Feb. 18	Feb. 20	.....	Feb. 14	Feb. 10	Feb. 10	Feb. 21	Feb. 20	.....	Jan. 29
Wasp (*Vespa vulgaris*)	.....	.....	Apl. 10	.....	Apl. 8	Apl. 3	Mar. 22	.....	.....	.....	Apl. 4
Small White Butterfly (*Pieris rapæ*)	May 3	May 4	.....	.....	.....	Apl. 19	Apl. 24	.....	.....	.....	Apl. 3
Orange-Tip Butterfly (*Anthocaris cardamines*)	.....	May 21	.....	.....	.....	May 18	May 17	.....	May 16	.....	May 7
Meadow-Brown Butterfly (*Epinephile janira*)	.....	.....	.....	.....	.....	May 19	.....	.....	June 20	.....	May 17

singularly gloomy, the record of clear sunshine falling short of the average during each of the three months.

During the cold period in January the temperatures were never sufficiently low to injure the winter crops; and moreover the snow came opportunely to shelter the young wheat and beans from the keen winds which at that time prevailed. It was a very fortunate circumstance for the farmer that the weather was not more severe, as the supply of roots and hay, owing to the poor crops of the previous year, happened at the beginning of the winter to be sadly deficient. In the gardens there was always plenty of green vegetables to be had, which is also a sure sign that no exceptionally severe frosts were at any time experienced.

The last rose-bloom of the year in my garden was knocked to pieces by driving rain on Christmas Eve, or three weeks later than the average date of its destruction in the previous eleven years. As an instance of how greatly the flowering of plants at this season may be retarded by untoward weather-influences, I may state that a patch of winter aconite in my garden had erect flowers upon it ready to open as early as January 6th, but they were not able to expand until February 7th, owing in the first instance to the paucity of sunshine, and afterwards to a covering of snow. So that the date for this flower, instead of being the earliest of all, was one of the latest that I have yet recorded.

The first appearance of fertile flowers on the hazel is noted by all the observers, and the mean date for the county comes out as ten days later than the average for this shrub in the previous 20 years. The coltsfoot, which flowered a fortnight later, when the temperature of the ground had risen a good deal after the January frost, was, however, five days early.

The song-thrush was first heard five days later than its usual time. The honey-bee first visited flowers eighteen days late.

The Spring.

The warm weather which prevailed in February continued throughout the whole of March, but during April and May the temperature was, as a rule, low for the time of year. What is known as the cold period in May was unusually well defined, the exposed thermometer showing from four to five degrees of frost on each of the four nights ending the 14th of that month. The rainfall of the spring quarter was also very unequally distributed, 57 per cent. of the total quantity having been deposited during March, whereas during May only in the last week was there any rain worth mentioning. In March the duration of bright sunshine was in no way remarkable; in April the record was very poor for a spring month; whereas in May the sun shone on an average for 7¾ hours a day—an exceptionally good record even for that sunny month. But, after all, the most noteworthy feature of this season as affecting vegetation was the small number of exceptionally cold nights.

At the end of March, which month closes the first half of the

drainage year, the total rainfall for the previous six months was as much as 3½ inches in excess of the mean quantity for that period. This excess of moisture in the soil, together with the frequent rains in March, caused that month to be one of the worst known for many years for sowing spring corn. Moreover, the conditions were not greatly improved during the dry period which followed, owing to the surface soil having run together during the wet weather and become hard, and difficult to work when afterwards exposed to the heat of the sun and drying winds.

For the grass lands this was on the whole a very favourable season, the ground remaining for the most part fairly warm and moist. In the gardens also the crops generally made good progress, and owing to the comparative freedom from spring frosts, tender plants passed through this quarter in most places with less check or injury than usual.

The cold spell in May appears to have been much more keenly felt in some parts of the county than in others. For instance, Mrs. G. E. Bishop reports that on the nights of the 11th and 12th of May not only were potatoes damaged in the open ground, but dahlias placed in cold frames were also cut by frost. Again, on the morning of the 12th of the same month one of our observers at St. Albans noticed on a pond near that city ice the thickness of a penny piece. At Berkhamsted the abundant flowering of wild violets and dandelions was worthy of note; and, on the other hand, so was the paucity of blossom on both the blackthorn and hawthorn bushes, many of which had no flowers on them at all.

Taking the spring quarter as a whole, the plants on the list came into flower somewhat in advance of their average dates. The mean records come out as follows:—The wood-anemone one day late, the blackthorn three days early, the garlic hedge-mustard five days early, the horse-chestnut three days early, the hawthorn four days early, and the white ox-eye two days late.

The spring migrants for which we have average dates made their appearance later than usual—the swallow arriving six days late, the cuckoo eight days late, and the nightingale six days late.

Turning now to the insects, the wasp was one day early, the small white butterfly more than three weeks late, and the orange-tip butterfly eleven days late.

The Summer.

The three summer months were all unseasonably warm, and on nine days the shade temperature rose above 80 degrees. During June and August rather more than the average quantity of rain fell, but in July the weather continued remarkably dry. June, although warm, had a deficient supply of bright sunshine. There were, however, capital records in the two following months, and especially in July, which proved the sunniest July since 1887—or for ten years.

The first half of this season was most propitious for all farm and garden produce. The corn and other field crops rapidly improved,

while a singularly heavy crop of hay was in most localities gathered in under favourable conditions. For although rain fell heavily at times during June, there occurred, on the other hand, in that month an unusually large number of days which were perfectly fine. At the end of July, however, the pastures and roots began to show evident signs of distress through the long continuance of dry weather. That the ground was at that time gradually becoming very dry, is shown by the fact that at the beginning of the third week in August no measurable quantity of rain-water had passed through either of my percolation gauges, the soil in which is 2½ feet deep, for nearly six weeks. No sooner had this drought come to an end than rain fell abundantly until the close of the season. The contrast between the first and second halves of August was very great, the former being warm, dry, and sunny, while the last fortnight proved cool rather than otherwise, besides being very wet and sunless. Consequently all the early-harvested corn was gathered in in good condition and with little trouble and expense, whereas that which remained in the fields after the middle of August was got together under trying conditions as regards weather. As was the case on the farms, so in the vegetable and flower gardens, the season continued particularly favourable until the July drought began to make itself felt, as was evidenced by the lawns, which soon became quite brown.

Writing from Harpenden Mr. Willis states that the first wheat-ear was out of its sheath on June 14th, or eleven days later than in the previous summer.

The wild dog-rose came first into blossom four days in advance of its average date, while the black knapweed was one day late, the harebell two days late, and the greater bindweed six days late.

The Autumn.

September proved cold, but during the latter half of October and nearly the whole of November the temperature remained unseasonably high. The warmest period of all was in the middle of October, during what is often termed "St. Luke's Little Summer." The three autumn months are generally among the wettest of the year, but during the autumn of 1897 less than half the average amount of rain for the quarter fell. September and November were gloomy months, while October, on the contrary, proved exceptionally sunny for the time of year.

The roots and pastures, favoured by the September rains and warm sunshine in October, made good progress, and the former became unusually well matured before the end of the season. Moreover, the soil was in such splendid order that winter corn was got in under the most favourable conditions possible; that is to say, until the dry weather in November had caused the ground to become so hard as to be in many cases almost unworkable.

Flowering plants in the garden have seldom blossomed so abundantly or so late in the year as during last autumn, particularly where the more tender kinds escaped injury from the

frosts of the second week in October. In my own garden the dahlias which had escaped without injury five degrees of frost on the night of October 6th, had the upper half of the plants killed by eight degrees of frost on the following night. They, however, lingered on in this crippled condition until November 19th, when they were killed to the ground by six degrees of frost. The average date of the destruction of dahlias in this neighbourhood for the previous twelve years has been November 1st, so that last year they were killed 18 days later than usual, and later than in any other year except 1894. Mrs. Bishop states that at Watford the very sharp frost of the 6th of October killed dahlias, heliotropes, beans, etc.

Apples and pears ripened their fruit earlier than usual, while the young shoots of all kinds of fruit-trees, roses, etc., owing to the favourable character of the autumn, also became well matured at an unusually early date.

Judging by the returns sent in to the 'Agricultural Gazette' from this county, the yield of wheat was, generally speaking, rather under average, while that of barley and oats was about average. Hay comes out as everywhere an abundant crop, beans as a good crop, peas and turnips as about average, and potatoes and mangolds as under average.

Treating the fruit-crop reports contributed to the 'Gardeners' Chronicle' in the same way that we have done the agricultural returns, we see at a glance that the year 1897 was by no means a prolific one. Pears and all the small fruits yielded about average crops, but the crop of apples was almost everywhere very poor, while that of plums was even more scanty.

The small number of wild fruits is noted by Mr. Willis. In the hedges at Harpenden he says there were but few sloes and not many hawthorn or holly berries, but an enormous quantity of hazel-nuts. On the other hand, Mr. Little mentions that at Hitchin the berries of the holly and hawthorn were abundant. Taking the county as a whole, I should say that the sparse flowering and fruiting of most wild shrubs and trees was a very general phenomenon, and rather difficult to satisfactorily explain, unless it be regarded as due to the dry summer and wet autumn of the previous year. The exceptions were blackberries and nuts, which were unusually abundant.

Deciduous trees, as a rule, retained their leaves unusually late in the year, and the autumn tints were singularly fine. Our observer at Watford, writing on November 20th, and remarking on the beauty of the autumn tints, adds: "they have lasted but a short time, and the trees are now almost leafless."

The last plant on the list, the ivy, taking the mean of all the observations sent in, flowered exactly a week in advance of its average date.

VIII.

MISCELLANEOUS NOTES AND OBSERVATIONS.

Read at Watford, 26th April, 1898.

Meteorology.

Meteor seen at Kensworth. — On Friday, the 21st of January, about 5.40 p.m., when walking out in a direction S.S.E., my attention was suddenly attracted by a light on the right. Turning round I saw a most brilliant meteor travelling from E.N.E. to W.S.W. on a course at an angle of about 30° to the earth. The head, of a yellowish white, appeared to be the size of a large cannonball viewed a few feet distant, and was followed by an elongated tail displaying some of the colours of the rainbow. The meteor was visible for about a second or two, then seemed to go out, then again became visible, and finally descended over the crest of the hill apparently a few fields off.—[*Miss*] *S. Grace Jones, The Grove, Kensworth.*

Botany.

Fly-Orchis at Cheshunt.—The fly-orchis (*Ophrys muscifera*) has been found at Cheshunt by my son, E. W. Paul. I note that in Pryor's 'Flora of Hertfordshire' it is not recorded as found at Cheshunt, and as we have no Chalk it is somewhat interesting how it reached here. It was on the edge of a stream which flows from the top of the ridge between Cheshunt and Brickendon or Bayford, and it must have been carried over so as to come into the water-transport of our chalkless brook. — *George Paul, High Bank, Cheshunt.*

Zoology.

An Egg within an Egg.—The other day my cook, in cutting open a hard-boiled egg, found a second diminutive egg inside it. The shell of this I am sending to you herewith for exhibition to the Natural History Society and for preservation in its Museum. I believe that instances of such a kind are not really uncommon, but it would be interesting to know the exact effect that the inner egg would have on the chick which would be hatched from the outer egg. Perhaps some monstrosities or "freaks" may be due to such a cause. — [*Sir*] *John Evans*, [*K.C.B., F.R.S.,*] *Nash Mills, Hemel Hempstead.*

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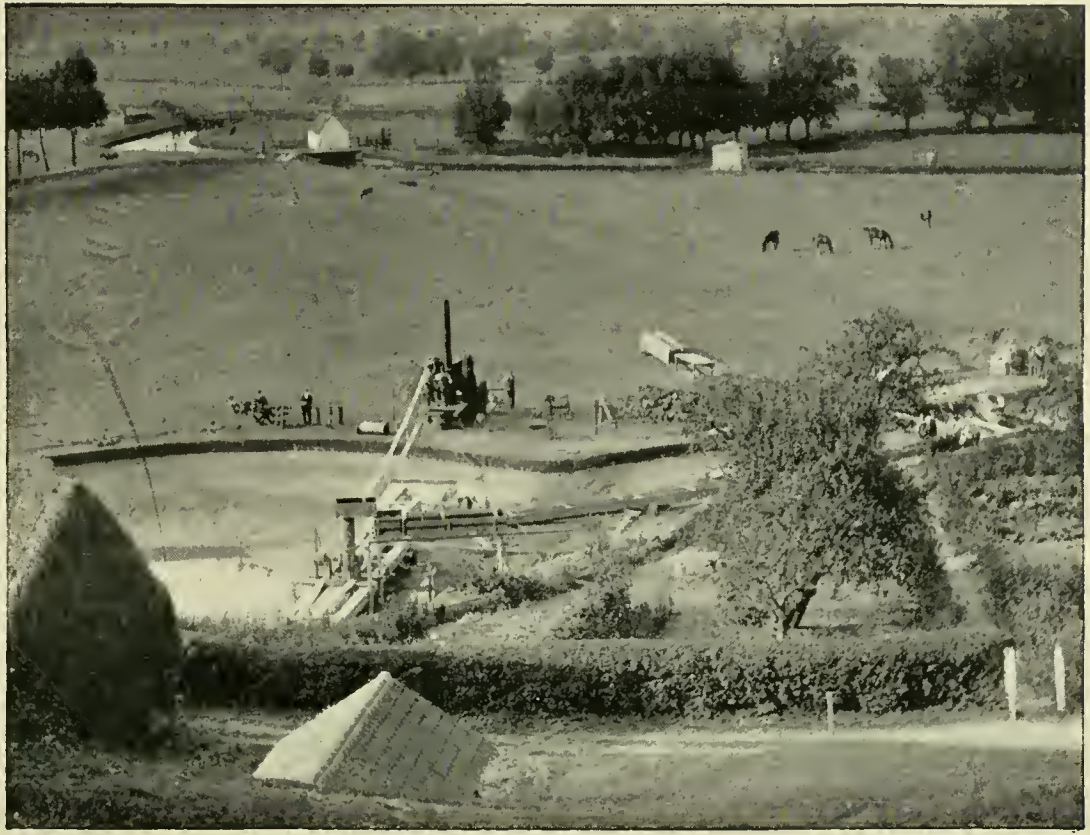

THE CHADWELL SPRING IN SEPTEMBER, 1898.

IX.

THE CHADWELL SPRING AND THE HERTFORDSHIRE BOURNE.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

Read at Watford, 15th November, 1898.

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PLATE I.

The Chadwell Spring.

For nearly three centuries has water been conveyed to London from the Chadwell Spring, and up to the autumn of the present year there is no recorded instance of the failure of this spring. About the beginning of last September it was noticed that instead of water flowing out of the basin of the spring, there was a considerable flow into it, the current in the cut which connects the spring with the New River being reversed. A dam was then erected across the cut, and the water of the River Lea thus being prevented from flowing into the basin of the spring, the level of the water in it sank several feet—nine feet it was reported, but it was scarcely seven feet below the outlet when I visited it, with our President, Mr. Whitaker, on the 24th of September.

The first question which should be considered is perhaps the reason why the water fell to this extent.

It is evident that when it was noticed that the current of the water was reversed, the spring, or group of springs, was acting as a "swallow-hole." Springs such as this are natural openings through which the water in our underground reservoir of saturated chalk readily finds its way to the surface. The term "reservoir" may perhaps convey a false impression which should be dispelled. Chalk is a substance which will absorb and retain in its interstices a considerable quantity of water—in fact one-third of its bulk—which, except where there are fissures in the chalk, will only gradually ooze through it: the water cannot freely flow until it finds an open channel. And the plane of saturation in the Chalk is not a well-defined surface as is the surface of a sheet of water. In dry weather, when no water is percolating into it, the Chalk is nearly dry at the surface, and gradually — imperceptibly — it becomes damp, until at last it is so wet that if a piece were cut out and brought to the surface we should see the water slowly ooze out of it. But wherever water runs out of the Chalk, as in springs and wells, it brings away some chalk with it, and so forms channels near the opening and makes it more porous further away, enabling it to hold more water than it does in its original state, and that water to flow more freely.

Water will not flow out of a spring unless there is water at a higher level than the outlet of that spring; it is the weight of the water above which causes the spring to rise; and that water

above, when held in the pores of unfissured chalk, can only gradually take the place of the water which flows out. Hence springs in the Chalk are what are called "permanent"; they do not depend upon the rain which falls at the time—they do not ebb and flow with the rainfall. It takes a long time for the rain to saturate the Chalk, and a long time for the water to drain out of it into the springs and rivers.

It therefore appears that the Chadwell Spring could not be flowing freely one day and absorbing water copiously the next; that when it became evident that water was flowing into the basin, it must have ceased to flow out of it for some time; and that the extent to which the water fell when the River Lea was stopped from flowing into it is a measure of the length of time which had elapsed since the spring ceased to flow. The reason why the water fell so many feet immediately the supply from the Lea was stopped, is that the plane of saturation in the Chalk had fallen to that extent, probably having been sinking for some months, first to the level of the outlet of the spring, and then to a level several feet below it, the normal level while the water was thus gradually sinking having been maintained in the basin of the spring by the water of the Lea flowing into it through the higher portion of the New River and the cut connecting it with the spring. I speak of it in the usual way as one spring although it is a collection of springs. I have seen the water bubbling up from about a dozen holes at the bottom of the basin.

I believe that it is as a rule about six or seven weeks before the spring fully responds to the rainfall, that is to say, that the greatest flow of the spring is about that time after the rain falls which has the greatest effect upon its volume; that it is nearly as long before dry weather affects it; and that if our reservoir of saturated chalk were in its natural state a fall of several feet in its level would be the result of a dry period many months beforehand. But it is not in its natural state; the large amount of water pumped up from great depths unnaturally exhausts it and causes fluctuations in the rainfall to be more rapidly and acutely felt, or rather the plane of saturation sinks more rapidly than it would otherwise do when the rain is in defect and rises more slowly when it is in excess. As, however, our springs are chiefly dependent upon the winter rainfall, it is unnecessary to attempt to determine the amount of this acceleration or retardation, our lack of underground water not being due to the drought of the summer in which it shows itself, but to dry weather some time beforehand. This is not the case with the surface-water which oozes out of the gravel above the Chalk, causing turbidity of the water in the basin of the Chadwell Spring shortly after rain.

Experiments continued for many years at Nash Mills near Hemel Hempstead, and at Lea Bridge, show that the average percolation through three feet of soil with grass growing on the surface is between seven and eight times as much in the six winter months, October to March, as it is in the six summer months, April

to September, being a little over six inches in the winter and about eight-tenths of an inch in the summer. There has frequently been no percolation whatever in the summer months; this has occurred in sixteen years out of forty-two, and without, so far as we know, very materially affecting the flow of the Chadwell Spring. In the summer of 1875 there was no percolation and the flow of the spring did not in any month average less than two and a half million gallons of water a day; in the summers of 1880 and 1881 there was no percolation and the flow of the spring was never less than two million gallons a day; and in the summer of 1883 there was no percolation and the flow of the spring was in one month only below two million gallons a day, and in that month, September, only just below it. The fall from two and a half to under two million gallons a day with no percolation in the summer months may be due to the gradual decline in the volume of the spring, which will be considered presently. It is not due to a decreasing fall in the previous winter, for the winter of 1882–83 was the wettest on record. I mention this fact merely to show that the total failure of the spring from at least the beginning of September, and probably a month or two earlier, cannot be due to the absence of percolation in the summer. (See Appendix.)

What is here assumed to be themean rainfall in Hertfordshire is the mean of that recorded at ten stations which have a record for at least a quarter of a century, the longest being the Nash Mills record of 64 years. The winter rainfall is that of the six months October to March, the summer rainfall is that of the six months April to September, and the yearly rainfall is that of the twelve months April to March, except when otherwise stated.

The mean rainfall in Hertfordshire during the winter of 1897–98 was 7·82 inches. During the last sixty-four years only once was there a less winter fall, and that was 6·08 inches in the winter of 1879–80. During the calendar year 1880 the Chadwell Spring did not yield so little as two million gallons a day in any month, the least being 2,178,000 in June. The summer of that year was a wet one, but at Nash Mills there was no percolation through the soil gauge. The previous summer, however, was excessively wet, 22·56 inches of rain having fallen, being about 70 per cent. above the average. In fact it was much the wettest summer on record, and the percolation at Nash Mills was 6·94 inches, which is more than an average winter's percolation, and double that of any other summer since the experiments were begun. In the summer of 1897, on the other hand, the rainfall was below the average, only 11·15 inches having fallen. The rainfall of the year 1879–80 was therefore 28·64 inches, and that of the year 1897–98 only 18·97 inches. This is the smallest recorded fall for a similar period, but twice it has not been an inch more; in the year 1870–71 it was 19·70 inches, and in the year 1854–55 it was 19·33 inches.

If we now take a period of eighteen months, including two winters and one summer, it will be found that the rainfall during the eighteen months ending 31st March, 1898, was but little

below the average, the winter of 1896–97 having been very wet. The rainfall during the eighteen months ending 31st March, 1855, on the other hand, was very small, the winter of 1853–54 having been a dry one. During the eighteen months in the earlier period 28·27 inches of rain fell, and during the eighteen months in the later period, 36·26 inches; in the earlier period 11·15 inches below the average, and in the later period only 3·16 inches below it. Two years after this earlier and much severer drought, the Engineer to the New River Company confirmed a statement made by his predecessor five years before that the minimum flow of the Chadwell Spring was 2,600,000 gallons per diem, while this recent drought has reduced it to nothing.

We have. however, no published record of the *monthly* flow of the Chadwell Spring earlier than the year 1875. The excessively dry winter of 1879–80 has already been considered. Since then there have been two periods of small rainfall which may very well be compared with that which we have just experienced. The rainfall during the winter of 1887–88 was 11·34 inches, during the summer and winter of 1887–88, 20·47 inches, and during the winter, summer, and winter of 1886–88, 35·54 inches. In the corresponding periods of 1889–91 the rainfall was 8·50 inches, 20·15 inches, and 31·72 inches. And in the corresponding periods of 1896–98, 7·82 inches, 18·97 inches, and 36·26 inches. The smallest monthly flow of the Chadwell Spring in the summers following these respective periods was, in the year 1888, 1,386,888 gallons per diem, in the year 1891, 562,588 gallons, and in the year 1898, *none.*

If our underground reservoir were each year entirely dependent upon the previous winter's rainfall for its supplies, we might expect the Chadwell Spring to be rather lower than it was in the summers of 1888 and 1891, but in that case it ought to have suffered more in the summer of 1880. It is not so, however. It has been argued that the present scarcity of water in the Chalk of the Lea Valley is the result of a very dry winter following a number of dry years or dry winters, but that is not the case. If we take the winter's rainfall in the water-supply engineer's period of three years, it will be found that the defect in the last three winters was not 1 per cent. of the mean, while for the three winters ending 31st March, 1891, it was 20 per cent. of the mean. In each of the four winters before the last one the rainfall was considerably in excess of the mean, and not only was the winter of 1896–97 very wet, but the year ending 31st March was also. In the last sixty-four years there have been only six wetter winters and eight wetter years.

The fact is that for the last four years we have been living in a "Fool's Paradise"; those of us at least who have relied upon the Report of the Royal Commission of 1892. Our rivers and wells have not suffered much, and, reassured by this fallacious Report, we have thought that all was going on well, heedless of the fact that we were having a wet time, or rather a succession of wet

winters. In the winter of 1893–94 the mean rainfall in Hertfordshire was 11 per cent. above the average for the half-century 1842–92, in that of 1894–95 it was 8 per cent. above it, in that of 1895–96 it was 6 per cent. above it, and in that of 1896–97 it was as much as 32 per cent. above the average. If we take the mean of each three successive winters the figures are—112, 106, 108, and 115 per cent. of the average. Now, with a winter's rainfall 40 per cent. below the average, and three successive winters ending last winter only 1 per cent. below the average, we get a rude awakening, the Chadwell Spring ceasing to flow, and the conclusions of Lord Balfour's Commission as to the water-supply which can be obtained from the valley of the Lea being shown to be utterly erroneous.

Let me divert your attention from this spring for a moment. Three or four miles below Hertford, a mile and a half below Ware, is one of the prettiest spots in Hertfordshire. Here, in a sheet of water with trees around and Amwell Church above, is an islet on which stands a pedestal erected to the memory of Sir Hugh Myddelton. In addition to inscriptions recording how "the Aquæduct meanders for the space of XL miles from the Spring of Chadwell and from this source of Amwell," is the following:—

> "Amwell, perpetual be thy stream,
> Nor e'er thy springs be less,
> Which thousands drink who never dream
> Whence flows the boon they bless."

This was written about the year 1800, and within the century it has become a record of the past. Fair Emma's Well has long since ceased to flow.

About four miles above Hertford is—or was, we may now say—another celebrated spring, Arkley Hole, in Woolmers Park. About ten years ago, I am informed, but I think, from the records of the rainfall, it must be eleven, the rushing of the water over the outlet of the pool which this spring has formed, could be heard at the house a quarter of a mile away. Now silence reigns supreme, for the spring is dead. It was noticed that it was ailing about eight years ago, and its decline was rapid. In a few years the water in the pool no longer rose to the outlet, and it was not even resuscitated by the very heavy rainfall of the winter before last, following three other wet winters, and causing the Hertfordshire Bourne to flow for the first time in fourteen years. The spring has frequently failed to flow for a time after dry winters, but the water in the pool is now lower than it is known to have ever been before. It was about three feet below the outlet when I saw it on the 1st of October. There is a spring on a lower level, very near it, which has never been known to fail, but which now yields only a small quantity of water.

Returning to the consideration of the Chadwell Spring, the bearing of the foregoing remarks upon the question which we are considering is apparent. The spring is declining in volume, steadily

declining, and I fear permanently. Its average annual flow is now about 40 per cent. less than it was 20 years ago, its yield being about a million and a half gallons a day less than it was then. The period for which returns of the monthly and annual yield of the spring are available is from January, 1875, to April, 1896. (See Appendix.) Dividing the 20 years ending 31st March, 1896, into four periods of five years each, the yield of the spring was as follows:—in the first lustrum, 3,609,600 gallons a day; in the second, 3,025,467; in the third, 2,785,184; and in the fourth, 2,328,294. If the 21 calendar years 1875–95 are divided into three periods of seven years each, the mean flow of the spring comes out thus:—in the first period, 3,603,000 gallons a day; in the second, 2,900,500; and in the third, 2,485,888. The mean flow for the whole of the 21 calendar years was 2,996,200 gallons per diem.

In 1852 Mr. C. W. Mylne, Engineer to the New River Company, stated that in his 40 years' experience he had never known the Chadwell Spring to yield less than 2,600,000 gallons per diem, a *minimum* considerably in excess of the present *average* yield.

In 1857 Mr. James Muir, who succeeded Mr. Mylne as Engineer to the New River Company, stated that the minimum gauged, as given by Mr. Mylne, was "a rare occurrence indeed," that the average was 3,600,000 gallons per diem, and that the yield in the beginning of that year was 6,300,000 gallons per diem.

In 1867 Mr. Muir gave the minimum yield which he could permanently rely upon as 3,200,000 gallons per diem, the daily average as 3,600,000, and the average yield in 1866 as 4,500,000 gallons per diem.

These are statements made before Royal Commissions or Parliamentary Committees, and in 1874 the Rivers' Pollution Commission, from the above and other evidence, came to the conclusion that the minimum yield had up to that time been 2,592,000 gallons per diem, and the maximum, 6,336,000, and estimated an average of 4,500,000 gallons per diem, but the only value attaching to this estimate is that the spring was then so powerful that it could have been seriously entertained. It shows the fallacy of deducing the average from the extremes, and we must fall back upon the average of 3,600,000, as given by Mr. Muir, and never questioned until 1892.

This, it will be seen, was about the average during the five years 1876–81 (April to March), and it was maintained to the early part of the year 1884. It might be inferred that there was nothing going on then to detrimentally affect the volume of the spring, did we not take the rainfall into consideration. During these five years the winter rainfall was 8 per cent. above the average for the half-century 1842–92, and the yearly rainfall 18 per cent. above it. With this heavy rainfall, aggregating 24 inches above the average, or nearly six years' average rainfall in five years, the Chadwell Spring gives a normal yield. In the five years 1881–86 the winter rainfall was 12 per cent. above the average, and the yearly

rainfall 5 per cent. above it, but the spring yielded 16 per cent. less than its average had been up to that time. In the five years 1886–91 the winter rainfall was 10 per cent. below the average, and the yearly rainfall 8 per cent. below it, the spring yielding 23 per cent. less than its former average. This is not a great falling-off in relation to the rainfall; but when we come to the latest period, the five years 1891–96 (ending 31st March), there is a very different state of things. The winter rainfall in this period was 10 per cent. above the average, and the yearly rainfall 1 per cent. above it, but the yield of the spring was 35½ per cent. less than the average as stated by Mr. Muir in 1867, and maintained to the early part of the year 1884 owing to the exceptionally heavy rainfall for the eight years preceding that date. This is the wettest period of such a duration since rainfall observations were commenced in Hertfordshire (at Nash Mills) 64 years ago, but the average flow of the Chadwell Spring was only just maintained.

It will be observed that the very great diminution in the flow of this spring in the five years 1891–96 coincides with the permanent failure of the spring at Woolmers, and took place during a period of more than average rainfall.

The Hertfordshire Bourne.

Until a few months ago the Chadwell Spring would have been considered to be as good an example as we could well have of a permanent Chalk spring, that is, of a spring which had never failed and under natural conditions was never likely to fail.

Let us now consider the case of a temporary spring rising from the Chalk when the plane of saturation, usually below the surface of the ground, is raised above the surface, the water from such a temporary spring flowing down the bottom of a valley which is usually dry, and thus forming a watercourse called a "bourne." The stream which sometimes flows into the Bulbourne at Bourne End, about half-way between Berkhamsted and Boxmoor, is an excellent example of such a bourne.

When I came to reside in Hertfordshire in 1874 I was told that the Bourne flowed, or was supposed to flow, once in every seven years. It had been flowing in the spring of the previous year, and therefore, on this assumption, most probably flowed in 1866 and was likely to flow again about the year 1880. I remember that my first impression on hearing this was that it took about seven years for the rain to accumulate underground until the Chalk could no longer hold any more; that the stream which then flowed formed a kind of syphon which emptied the underground reservoir to a certain extent, and that it took about seven years' rainfall to fill it again. This notion was dispelled by the Bourne itself in 1876, for it appeared in that year, three years after its previous appearance, and I learned the correct theory from a paper by Sir John (then Mr.) Evans on "The Hertfordshire Bourne," which appeared in an early part of our 'Transactions.' ('Trans.

Watford Nat. Hist. Soc.,' Vol. I, p. 137.) There must, however, have been some grounds for the idea that the Bourne flowed once in every seven years; it must at least have flowed about seven years before 1873, probably in 1866, and that it did so is corroborated by the rainfall, as mentioned by Sir John Evans in this paper. He also states that it flowed in 1853, and probably in 1860, and this date is confirmed by Mr. Littleboy in a short note on "The River Bourne" which appeared in our 'Transactions' in 1883. ('Trans. Herts. Nat. Hist. Soc.,' Vol. II, p. 237.) Mr. Littleboy here says: "I may mention that during thirty years prior to 1860, the Bourne only overflowed its banks in the garden through which it passes opposite the Bourne End mill on one occasion." From this it may be inferred that not only did it flow in 1860, but that it also overflowed into this garden, but no further particulars of its flowing then are given. We have, therefore, intervals of seven, six, and seven years between the appearance of this intermittent stream before the year 1873. Since then it flowed much more frequently up to the year 1883, during the wettest period in our Hertfordshire record, from which time fourteen years elapsed before it again flowed last year.

I have seen the Hertfordshire Bourne at one time rising about a mile up its valley, a mile, that is, above its confluence with the Bulbourne; at another time at Bottom Farm, two miles up; at another where Harratts End Lane crosses its valley, a mile further up; and at other times still higher. The position of the spring from which it rises varies from time to time, sometimes being much higher up the valley than it is at others, but however high the Bourne may rise, there can be little doubt but that the spring at its ultimate source is but one of several by which its volume is successively augmented lower down the valley.

In 1883 the Bourne commenced to flow at Bourne End; I last saw it flowing on the 19th of June, 1897, from half a mile to a mile higher up the valley. When rising at these low points the plane of saturation of the Chalk was evidently only slightly raised above its normal height, its angle with the horizontal being a small one, but when rising at the highest point, the highest on record being in the third field above Harratts End Lane, this plane must have been much more raised, forming a greater angle with the horizontal. Then the stream would probably be augmented by springs at each point lower down its valley where it has risen at any other time, for if springs rose at these points when the plane of saturation was less inclined, they would surely continue to rise when the inclination was increased. When there is a slight rise in the ground the stream sometimes disappears, appearing again lower down, so that it may, perhaps, be rather looked upon as a stream which flows partly underground and partly over the surface, than as one which rises from a spring and is augmented by springs on its course.

The Bourne usually commences to flow between January and April, frequently some time after the rain which causes it to flow

has ceased, this interval being occupied by the water which falls upon the surface of the ground percolating through the Chalk to the normal plane of its saturation, which has to be raised to a greater angle with the horizontal than that of the bottom of the valley, and at the point where the plane of saturation intersects the bottom of the valley, the water commences to flow above the surface of the ground, there being at this point a temporary spring. The inclination of the valley of the Bourne is from about 15 feet to the mile in its lower portion to 20 feet near its head. The frictional resistance of the pores of the Chalk against the force of gravitation causes water in it to flow from the higher ground to the rivers at an inclination of at least 12 feet to the mile. In wet weather this inclination is much increased, and it is evident that the stream will only flow when it is greater than the inclination of the valley of the Bourne.

It is not, however, my intention to go fully into the theory of bournes, for that has already been done by Sir John Evans in the paper to which I have referred. I merely wish here to attempt to show what amount of rain is required to cause our Bourne to flow, by comparing the recorded instances of its flow with the rainfall of the preceding winter or year, the winter and the year being the six months or the twelve months ending 31st March. The Bourne has certainly flowed ten times during the last half-century, and in twelve years during this period the mean rainfall in Hertfordshire has exceeded 30 inches. The Bourne has never flowed when less than this amount of rain has fallen, and therefore only twice has it failed to flow when the year's rainfall has exceeded 30 inches. In fact we can only be certain that this has occurred once, and that was in the year 1892, when the year's rainfall was 30·21 inches (to 31st March), and the winter's 16·61 inches. The other year with no record of its flow and no grounds for inferring that it must have flowed, was 1861, when the year's rainfall (to the usual date) was 31·31 inches, and the winter's 11·81 inches, this probably being too small a winter's fall to cause it to flow. That it did not flow in 1892 may be owing to the winter of 1890–91 having been a dry one.

The following table (Table I, p. 79) gives the mean summer, winter, and yearly rainfall in Hertfordshire (the mean of ten gauges) whenever the Bourne has certainly flowed, with the ratio to the average for the half-century 1842–92. It will be seen that the Bourne has never flowed, so far as we know, unless there has been an excess of at least 4¼ inches of rain in the year, all due to the winter's fall (1896–97); of at least 5⅓ inches, of which the winter's excess was 2 inches (1859–60); or of at least 6⅓ inches, of which the winter's excess was 1⅓ inch (1878–79). The only other years with a rainfall above 30 inches are 1860–61, when the excess was 5 inches and the winter's defect 1¼ inch, and 1891–92, when the excess was 4 inches, the winter's excess being 3⅔ inches. On the first of these occasions the Bourne may have flowed, but, owing to the small rainfall in the winter, it is scarcely likely to have done so; on the

second we know that it did not, although, from the heavy winter's rainfall and rather large year's fall, it was at least likely that it might do so.

It may be objected that the mean rainfall in Hertfordshire does not represent that which falls in the valley of the Bourne. I have therefore compiled another table (Table II, p. 79) showing the mean rainfall at two places, one a short distance above Bourne End and the other a short distance below it—Berkhamsted, and Nash Mills near Hemel Hempstead—for each year preceding the flowing of the Bourne from 1853 to 1897. In this table the year is divided into quarters, and the rainfall of the nine months ending 31st March, and year's rainfall ending the same date, are also given. For the year 1852–53 it is that of Nash Mills only, observations not having then been commenced at Berkhamsted. It may be observed that, although in the last year in which the Bourne appeared there was less rainfall than in any other of the series, it was probably quite as effectual as in several other years, for the deficiency is more than accounted for by the small fall in the second quarter of 1896, when, owing to vegetation being in its most active state, but little rain usually gets into the Chalk out of the reach of evaporation. There was an average *year's* rainfall in the nine months, July, 1896, to March, 1897.

It may be suggested that the flowing of the Bourne is not altogether dependent upon the rain which has fallen during the preceding twelve months. Water percolates through the unfissured Chalk very slowly, and the plane of saturation may and doubtless does stand at a higher inclination one summer, after all percolation has ceased for a time, than at another, so that when a period of excessive rainfall comes, the rain may not always have the same depth of chalk to percolate through, and therefore after a wet year, or series of wet years, a smaller amount of rain would be required to cause the Bourne to flow than after a dry year, or series of dry years.

The mean rainfall at Berkhamsted and Nash Mills for the year ending 31st March, 1892, was half an inch more than it was for the year ending 31st March, 1897. If the flowing of the Bourne depended upon the amount of rain which falls in a single year, irrespective of the time of the year at which it falls, it would be more likely to have flowed in 1892 than in 1897. The mean rainfall at these two places for the year 1890–91 was six inches less than it was for the year 1895–96. (See Table III, p. 80.) This gives five inches and a half more for the two years together at the later period, when the Bourne did flow, than at the earlier, when it did not. This is a strong point in favour of the idea that some portion of one year's rainfall may be stored up in this valley above the normal plane of saturation until it receives further accession from the following year's fall, as it would be in a valley of less inclination with a permanent river, but it is not conclusive. Again, not only was the rainfall of the year 1890–91 much less than was that of the year 1895–96, but that which did fall was much less

TABLE I.—*Mean Rainfall in Hertfordshire for each Summer, Winter, and Year preceding the flowing of the Bourne since* 1852, *with the Ratio to the Mean for the Half-century* 1842–92.

Year.	Summer. April–Sept.		Winter. Oct.–March.		Year. April–March.	
	ins.	%	ins.	%	ins.	%
1852–53	18·50	140	18·58	142	37·08	141
1859–60	16·58	125	15·15	116	31·73	120
1865–66	12·46	94	19·68	150	32·14	122
1872–73	13·69	103	19·44	148	33·13	126
1875–76	15·99	121	17·10	131	33·09	126
1876–77	13·67	103	19·45	148	33·12	126
1878–79	18·15	136	14·58	111	32·69	124
1880–81	16·21	122	17·83	136	34·04	130
1882–83	14·53	110	20·24	155	34·77	132
1896–97	13·34	101	17·29	132	30·63	116
Mean 1842–92	13·24	100	13·09	100	26·33	100

TABLE II.—*Mean Rainfall at Berkhamsted and Nash Mills for each quarter of the year, and each* 9 *months and year, preceeding the flowing of the Bourne since* 1852.

Year.	2nd qr. April–June.	3rd qr. July–Sept.	4th qr. Oct.–Dec.	1st qr. Jan.–March.	9 months. July–March.	Year. April–March.
	ins.	ins.	ins.	ins.	ins.	ins.
1852–53	7·32	12·65	14·51	5·74	32·90	40·22
1859–60	8·00	9·92	9·55	7·14	26·61	34·61
1865–66	4·91	7·37	11·35	9·60	28·32	33·23
1872–73	8·47	6·57	13·92	8·26	28·75	37·22
1875–76	6·80	9·19	10·59	7·83	27·61	34·41
1876–77	5·52	8·91	11·37	9·59	29·87	35·39
1878–79	10·83	8·60	8·30	7·72	24·62	35·45
1880–81	4·97	12·41	13·31	7·15	32·87	37·84
1882–83	9·72	6·58	14·15	8·85	29·58	39·30
1896–97	2·87	10·45	9·00	8·80	28·25	31·12
Mean	6·94	9·27	11·60	8·07	28·94	35·88

effective for percolation, the defect in the amount being almost entirely in the winter months. And not only so, but the effective or winter rainfall of the three years preceding 1890–91 was much less than that of the three years preceding 1895–96. The probability is therefore very strong that before the very wet year 1896–97 the store of underground water in this valley was much greater than it was before the very wet year 1891–92. But that it was so is not *proved* by the flowing of the Bourne in 1897. It is necessary to take into consideration the time of the year at which the excessive amount of rain fell. Though the average fall at Berkhamsted and Nash Mills during the twelve months preceding the outburst of the Bourne in 1897 was half an inch less than it was in the corresponding period of 1891–92, nearly two inches and a half more fell in the nine months preceding its outburst in 1897 than in the corresponding nine months in the earlier period. It therefore seems that the flowing of the Bourne in 1897 and not in 1892 is just as likely to be due to the rain having fallen at a more propitious time for percolation, that is, later in the year 1896 than in the year 1891, as it is to the presence of an excess of stored-up water from the rainfall of the previous year or years.

TABLE III.—*Mean Rainfall at Berkhamsted and Nash Mills for various periods during the years* 1890–92 *and* 1895–97 (*April to March*).

Year.	2nd qr. April-June.	3rd qr. July-Sept.	4th qr. Oct.-Dec.	1st qr. Jan.-March.	Winter. Oct.-March.	9 months. July-March.	Year. April-March.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1890–91	5·10	6·55	5·14	3·45	8·57	15·14	20·24
1891–92	5·72	8·10	14·31	3·49	17·80	25·90	31·62
1890–92	10·82	14·65	19·45	6·94	26·39	41·04	51·86
1895–96	2·57	9·48	9·60	4·62	14·22	23·70	26·27
1896–97	2·86	10·45	9·00	8·80	17·80	28·25	31·11
1895–97	5·43	19·93	18·60	13·42	32·02	51·95	57·38

This view is very strongly supported by the records of percolation at Rothamsted. In eight of the last 25 years the percolation through five feet of soil with the surface kept free from vegetation has exceeded 20 per cent. of the average for the 27 years 1871–98 (April to March). In 1875–6 it was 26 per cent. above the average; in 1876–7 it was 38 per cent. above it; in 1878–9, 39 per cent.; in 1880–1, 49 per cent.; in 1882–3, 50 per cent.; in 1885–6, 23 per cent.; in 1891–2, 26 per cent.; and in 1896–7, 70 per cent. In this last year the average was thus exceeded by 44 per cent. more than it was in 1891–2, the actual excess of the one year over the other being six inches. Allowing for the fact

that in these experiments at Rothamsted the surface of the ground is kept in an artificial condition which is highly conducive to excessive percolation, by which the excess of six inches would probably be reduced to about four inches through soil in its natural state, there is no need to fall back upon the supposition of a reserve store of underground water to account for the flowing of the Bourne in 1897, although this supposition is most probably correct.

In the period referred to the Bourne has always flowed when the percolation at Rothamsted has *exceeded* 26 per cent. of the average, and never when the excess was less than 26 per cent.; it flowed in 1876 when the excess *was* 26 per cent.; and it did not flow in 1892 with the same excess of percolation.

An inch of rain falling on an area of a square mile yields nearly 14½ million gallons of water. The catchment-basin of the Bourne is at least five square miles in area. Each inch of rain which percolates throughout this area down to the plane of saturation of the Chalk should therefore yield at least 72½ million gallons of water. When the Bourne was visited by the Society on the 24th of April, 1897, the flow was about one million gallons a day. It commenced to flow at the beginning of that month and ceased before the end of June. It would not have flowed so fast at first, and even by the 19th of June the flow was very small indeed. It is scarcely likely to have averaged a million gallons a day for 70 days, and therefore it is not likely that more than an inch in depth of rain flowed over the surface of the ground. If we may form any judgment of the probable percolation in the catchment-basin of the Bourne from the experiments at Rothamsted, the only remarkable circumstance about the flowing of the Bourne in 1897 would be that it did not then flow from such a high point in the valley, nor consequently in so great a volume, as it has done on some previous occasions.

Concluding Remarks.

The facts here presented as to the flowing of the Hertfordshire Bourne do not appear to me to confirm the deduction that there has been a material depletion in our store of underground water in the valley of the Colne and its tributaries, nor to negative such an inference. It was about as likely that the Bourne would flow in 1892 as it was that it would not, and it did not. I was certain that it would flow in 1897, but it did not appear so early as I expected it to do, for I went to look for it twice in March before its outburst occurred.

The valley of the Lea tells a very different tale. The decline in the volume of the Chadwell Spring, and the total cessation of the spring at Woolmers, in a period of more than average rainfall, leave no room for doubt that there has been a very considerable depletion in the store of water in that valley. There must be something affecting the valley of the Lea which is not affecting the valley of the Colne, or at least to any material extent. In a quarter of a century the New River Company has increased the

amount of water taken from the valley of the Lea by 14 million gallons a day. This is the increase from wells and springs, and, as the springs are yielding less, the draught upon our underground reservoir of saturated chalk by means of wells must have increased to a greater extent than this. During the 20 years 1872 to 1891 the New River Company, gradually increasing their take, drew from wells and springs in the Lea Valley an average quantity of 6,223,800 gallons per diem, and during the four years 1892 to 1895, still increasing, an average of 14,151,718 gallons per diem. Very much the greatest increase has therefore taken place during the last four of these 24 years, and I think there can be no room for doubt that the 5 or 6 thousand million gallons of water per annum which the New River Company is now drawing from the Chalk of the Lea Valley has had a material influence in bringing about a scarcity of water in this valley.

That this would be the result of excessive pumping from the Chalk was foreseen thirty years ago. In the report of the Royal Commission on Water Supply of 1867–68, generally known as the Duke of Richmond's Commission, the following words occur:— "We do not agree with those who expect to get an almost unlimited increase of quantity of water by simply tapping the natural reservoirs in the chalk, for the supply to them must obviously be limited by the amount of rainfall. Moreover, as the water which penetrates into the reservoirs, raising the water-line more or less above the level of the adjoining valleys, ultimately in greater part finds its way by springs into streams at the lower level of the district, any water drawn from the store by artificial means will most probably be at the expense of those streams. If this be true, it follows that any water obtained by tapping the chalk reservoirs that feed either the River Lea or the Thames above Hampton, would only *pro tanto* diminish these streams, and would therefore be little or nothing gained to the general supply." This view has been urged on more than one occasion by Sir John Evans, and so recently as the 31st of last August he wrote a letter to 'The Times' in which he said that "if the pumping is excessive, the natural courses through which the springs would rise into the stream will be converted into channels by which the water of the stream will be conveyed by gravitation into the wells." When this was written, the very thing which he predicted was, unknown to him, actually occurring at the Chadwell Spring. An immense expense has therefore been incurred by the New River Company to dry their own springs and deplete the River Lea from which they principally obtain their supply, and in so doing they have deprived the East London Company of their usual river supply, as well as themselves, with a result which is well known.

The lesson to us here is that we should endeavour to prevent, by all means in our power, the same thing happening in the valley of the Colne. We may then again see the Bourne flowing after there has been no more rainfall than has caused it to flow hitherto.

Appendix.

Since the above was written and read before the Society I have been kindly favoured by Mr. Francis, the present chief Engineer to the New River Company, with particulars of the weekly flow of the Chadwell Spring up to the time of its cessation, which is shown by the gaugings to have been between the middle and end of July, thus confirming my conclusion that it must have ceased to flow a considerable time before it was reported to have done so about the beginning of September.

This has enabled me to extend by two years the comparison of the flow of the spring with the rainfall, bringing it up to the 31st of March, 1898. Taking the 23 years from April, 1875, to March, 1898, in periods of 6, 6, 6, and 5 years, the result is as follows :—

Period.	Rainfall.					Spring. Mean flow per day.	
	Summer.	Winter.		Year.			
	ins.	ins.	%	ins.	%	Gallons.	%
1875–81	16·85	14·57	111	31·42	119	3,640,350	101
1881–87	12·77	14·71	113	27·48	104	3,073,200	85
1887–93	13·10	12·07	92	25·17	96	2,644,180	73
1893–98	11·64	13·53	103	25·17	96	2,275,040	63

The ratios are to the rainfall of 1842 to 1892 (April to March), and to 3,600,000 gallons per day as the accepted mean flow of the spring up to at least the year 1874.

It is curious that the mean rainfall in the five years 1893 to 1898 should be exactly the same as that in the six years 1887 to 1893, but still more so that with a heavier winter rainfall in the later period the flow of the Chadwell Spring should be much less than it was in the earlier period. It appears to me to prove that our Chalk reservoir is being depleted by the excessive pumping from deep wells, the plane of saturation in the valley of the Lea being permanently lowered.

Explanation of Plate I.

In the foreground is the basin of the Chadwell Spring. Erected over it is a centrifugal pump by means of which the water is kept at a lower level than it would otherwise assume, so that the basin may be cleaned out, and part of one side which had given way may be concreted. In the channel to the right a sluice is being built to cut off the water of the New River whenever the spring may fail. The temporary dam across the channel is a little further to the right. In the distance is the New River, which flows out of the River Lea opposite Ware Park. Adjoining the White House on it (a tool-house) is a weir over which any surplus water may flow into the Manifold Ditch, and thence, by the Hertford sewage-effluent, back into the Lea. The old marble gauge (now disused) is seen a little to the right of this building.

The plate is from a photograph by Mr. Alfred Poore, of Hertford.

X.

A LIST OF THE BIRDS OF HERTFORDSHIRE.

By Alan F. Crossman, F.L.S.

Read at Watford, 13th December, 1898.

This list of the Birds of Hertfordshire has been compiled by me from information obtained from the various Reports which have appeared from time to time in the 'Transactions' of this Society, and of its predecessor the Watford Natural History Society. I do not vouch for the accuracy of all the records, but have taken them as I found them in the Reports, adding thereto information which I have myself obtained. Some of the records which are included in this paper are in my opinion very open to doubt, and require corroboration before one can consider them as properly authenticated. I have enumerated almost every species which has been recorded in our 'Transactions,' but at the same time I must point out that several of the birds are undoubtedly introduced species, and that one at least is most probably a mere escape. By introduced species I should say that I refer to birds which have originally not inhabited the British Isles, but which, having been turned down, have now become practically naturalized. There was no actual list of the birds of Hertfordshire in existence, and anyone interested in our county fauna had to wade through the 'Transactions' of about 25 years to obtain a general knowledge of our birds. This list, I hope, will partially get over that difficulty, and if it is the means of furthering the knowledge of the birds of Hertfordshire, it will have done its work. Perhaps also it may be the means of bringing forward additional evidence in those cases which are to my mind doubtful at present, so that such records may be either expunged from our list or may be more firmly established therein.

1. Missel-Thrush (*Turdus viscivorus*).—Resident. Common in wooded localities.

2. Song-Thrush (*Turdus musicus*).—A common resident.

3. Redwing (*Turdus iliacus*).—A fairly plentiful winter visitor in varying numbers, usually arriving towards the end of October.

4. Fieldfare (*Turdus pilaris*).—A common winter visitor, appearing about the beginning of November.

5. Blackbird (*Turdus merula*).—A common resident. Pied varieties have frequently been seen in the county.

6. Ring-Ouzel (*Turdus torquatus*).—Although this bird is not recorded annually, it is probably a fairly regular visitor on the spring and autumn migration. One very noticeable fact about its visits is the late date on which it has often been seen.

7. Rock-Thrush (*Monticola saxatilis*).—The only authenticated instance of the occurrence of this species in the British Isles is that of a specimen obtained on 19th May, 1843, at Therfield, in Hertfordshire. The bird was a male, and was examined in the

flesh by the late Mr. Yarrell, who figured it in his book on 'British Birds.' It is now in the collection of Mr. F. D'Arcy Newcome, of Feltwell Hall, Norfolk.

8. Wheatear (*Saxicola œnanthe*).—This bird is a regular visitor on the spring and autumn migration, and formerly nested in some numbers along the northern boundary of the county, though now only doing so in a few localities.

9. Whinchat (*Pratincola rubetra*).—A regular summer visitor, nesting in most parts of the county.

10. Stonechat (*Pratincola rubicola*).—Resident. Found in varying numbers on many of the commons in Hertfordshire, and in some places occasionally staying through the winter. It is an early nester, and the nest is extremely difficult to find.

11. Redstart (*Ruticilla phœnicurus*).—A regular summer visitor, nesting in most localities.

12. Black Redstart (*Ruticilla titys*).—On 28th March, 1893, Mr. Sainsbury Verey identified a male of this species at Heronsgate near Rickmansworth, where it remained for two or three days. This is the only occasion on which this bird has been recorded in Hertfordshire.

13. Redbreast (*Erithacus rubecula*).—A common resident. Our 'Transactions' contain several instances of curious nesting-sites used by this species, and also some records of albinism.

14. Nightingale (*Daulias luscinia*).—A summer visitor, common in suitable localities, although I believe it is scarce towards the north of the county.

15. Whitethroat (*Silvia cinerea*).—A common summer visitor.

16. Lesser Whitethroat (*Silvia curruca*).—A summer visitor, plentiful though inclined to be very local.

17. Blackcap (*Silvia atricapilla*).—A fairly plentiful summer visitor in suitable localities.

18. Garden-Warbler (*Silvia hortensis*).—A summer visitor in small numbers to parts of the county. It is a bird which seems to prefer small copses and the edges of large coverts.

19. Dartford Warbler (*Silvia undata*).—A pair were seen by Mr. C. Worte on 1st May, 1897, on Common Wood Common, near Chipperfield, and were apparently nesting there. This is the only recorded occurrence of this bird in Hertfordshire, although many parts of the county abound in places suitable for it.

20. Golden-crested Wren (*Regulus cristatus*).—A not uncommon resident in suitable localities.

21. Fire-crested Wren (*Regulus ignicapillus*).—The Hon. Walter Rothschild informed the late Mr. Littleboy that a bird of this species was shot at Tring on 1st January, 1887.

22. Chiffchaff (*Phylloscopus rufus*).—A fairly plentiful summer visitor, arriving about the last week in March.

23. Willow-Wren (*Phylloscopus trochilus*).—A common summer visitor.

24. Wood-Wren (*Phylloscopus sibilatrix*).—Fairly plentiful in many of the woods on the western side of the county, although

very erratic in reappearing in its old haunts, often forsaking them for other woods in the neighbourhood. The nest, which is built on the ground, is usually most difficult to find.

25. Reed-Warbler (*Acrocephalus streperus*).—A common summer visitor to the Tring Reservoirs and other suitable localities.

26. Marsh-Warbler (*Acrocephalus palustris*).—A specimen of this bird was shot on one of the Tring Reservoirs in August, 1883, and is now in the Tring Park collection.

27. Great Reed-Warbler (*Acrocephalus turdoïdes*).—Mr. More, in his paper on the "Distribution of British Birds," in the 'Ibis' for 1865, mentioned that the late Mr. F. Bond stated that a nest of this bird had been obtained in Hertfordshire. No further information appears to be forthcoming, and the statement is open to great doubt.

28. Sedge-Warbler (*Acrocephalus phragmitis*).—A fairly plentiful summer visitor, nesting often in localities not in the immediate neighbourhood of water.

29. Grasshopper-Warbler (*Locustella nævia*).—A plentiful summer visitor to many of the commons in the county.

30. Hedge-Sparrow (*Accentor modularis*).—Common and resident.

31. Dipper (*Cinclus aquaticus*).—A young male in perfect plumage was obtained at Westmill on the River Orton near Hitchin in December, 1848. The late Mr. Littleboy also on two occasions about 1874 recognized this species near Hunton Bridge.

32. Bearded Titmouse (*Panurus biarmicus*).—On 21st December, 1848, a male and female were shot at the Tring Reservoirs, while about the same time a small party was seen on the banks of the Orton near Hitchin. On 12th July, 1888, Mr. Taylor recognized a male on the Hertfordshire bank of the River Stort near Bishop's Stortford.

33. Long-tailed Titmouse (*Acredula rosea*).—Resident and plentiful.

34. Great Titmouse (*Parus major*).—Resident and common.

35. Coal-Titmouse (*Parus ater*).—Resident and plentiful.

36. Marsh-Titmouse (*Parus palustris*).—Resident and plentiful.

37. Blue Titmouse (*Parus cæruleus*).—Resident and common. Several curious nesting-sites of this species have been recorded in our 'Transactions.'

38. Nuthatch (*Sitta cæsia*).—Resident and plentiful in many of the wooded parts of the county.

39. Wren (*Troglodytes parvulus*).—Resident and common.

40. Tree-Creeper (*Certhia familiaris*).—Resident and fairly plentiful in well-timbered localities.

41. Pied Wagtail (*Motacilla lugubris*).—Common, often staying through the winter.

42. White Wagtail (*Motacilla alba*).—First recognized in Hertfordshire by Mr. H. S. Rivers at Sawbridgeworth in 1895. In that year he also found in a thick yew hedge a wagtail's nest containing twelve eggs, near which he saw both pied and white

birds. Since 1895 this bird has been seen on several occasions, and I have reason to believe that it has at least on one occasion nested near Great Berkhamsted.

43. Grey Wagtail (*Motacilla melanope*).—A regular winter visitor in small numbers to the western side of the county. A nest with eggs was found some years ago at one of the Tring Reservoirs.

44. Yellow Wagtail (*Motacilla Raii*).—A summer visitor, inclined to be local.

45. Tree-Pipit (*Anthus trivialis*).—A plentiful summer visitor.

46. Meadow-Pipit (*Anthus pratensis*).—A common winter visitor. In suitable localities, chiefly on the northern boundary of the county, a few pairs remain to nest.

47. Water-Pipit (*Anthus spipoletta*).—Two of these birds are said to have been shot at the watercress beds at Berkhamsted in 1886, and to be preserved in the Tring Park collection.

48. Golden Oriole (*Oriolus galbula*).—In June, 1881, a nest of the golden oriole is stated to have been found in a high thorn hedge at Charlie Farm, Amwell, near Ware, by Mr. Beningfield. Although the situation appears an unusual one, the late Mr. Littleboy, who saw the eggs and compared them with authenticated specimens, was quite positive as to the correctness of the record. On 4th June, 1886, a golden oriole was shot on the borders of Sherrard's Wood, Digswell, near Welwyn, and was preserved, while on 20th July, 1888, a pair were seen near Broxbourne, one of which was nearly caught in a fruit-net.

49. Great Grey Shrike (*Lanius excubitor*).—In January, 1881, two of these birds were shot at Boxstead, near Hemel Hempstead. One was shot in November, 1882, near Throcking, and in the same year another was shot near Elstree. In 1883 a specimen was obtained near Hertford on December 16th, and on the 26th of the same month one was seen at Weston Manor. On 23rd September, 1884, one was shot at Tyler's Farm, near Bushey, while in the next year a bird of this species was obtained in Ware Park on March 16th. In January, 1886, Mr. F. Sutton shot one, which is still in his possession, at Hill Farm, Northchurch. In 1887 one remained for a fortnight in July in the parish of Willian, near Stevenage, and in November in the same year a bird of this species was caught by a birdcatcher near Hitchin and was afterwards released. In October, 1888, one appeared at Tring, and on 5th December, 1890, Mr. H. S. Rivers shot a young male, which is now in his possession, on Roderick's Farm, near Latton Mill. In addition to the above Mr. Latchmore has a specimen which was shot on Norton Common, near Baldock, some years ago.

50. Red-backed Shrike (*Lanius collurio*).—A fairly plentiful summer visitor, more especially to the northern parts of the county. It is also increasing in the west of Hertfordshire.

51. Woodchat (*Lanius pomeranus*).—In the spring of 1856 a woodchat was shot near Baldock, and in 1873 the Rev. H. A. Macpherson identified one near Hertford.

52. Waxwing (*Ampelis garrulus*).—A waxwing was shot near

Tring about 1850, and in 1870 a specimen, which passed into the possession of Mr. How, was shot at Cupid's Green, Hemel Hempstead. The late Dr. Brett mentioned that one was shot in 1874 in the Watford Fields, and in 1881 two were shot near Ware. These latter were in the possession of Mr. Chapman, of Bennington. In March, 1883, a specimen was obtained at Tring, in January, 1893, one was picked up dead by the side of the Lea, and on February 27th in the same year two were shot at Northaw. The latest record of this bird in Hertfordshire is of two which were shot at Radlett by the station-master there, in the autumn of 1895.

53. Pied Flycatcher (*Muscicapa atricapilla*). — During the summer of 1879 a specimen was obtained near Royston, and on 13th May, 1887, one was shot near Stevenage. In 1896, during the summer, a pied flycatcher was seen in Hitchin and was eventually shot, but being badly damaged was not preserved. On 23rd April, 1897, I saw a fine male near Great Gaddesden, and on 24th April, 1898, and the following day, the Hon. A. Holland-Hibbert saw one at Munden. There is also mention made in our 'Transactions' of a bird preserved by a Mrs. Young, of Bennington, but no further particulars are given.

54. Spotted Flycatcher (*Muscicapa grisola*).—A common summer visitor.

55. Swallow (*Hirundo rustica*).—A common summer visitor.

56. House-Martin (*Chelidon urbica*).—A common summer visitor.

57. Sand-Martin (*Cotile riparia*).—A local summer visitor.

58. Greenfinch (*Ligurinus chloris*).—Common and resident.

59. Hawfinch (*Coccothraustes vulgaris*). — Plentiful on the western side of the county and not uncommon in other localities; decidedly on the increase. Resident.

60. Goldfinch (*Carduelis elegans*).—Resident and not uncommon. Slightly on the increase, but sadly persecuted by bird-catchers.

61. Siskin (*Chrysomitris spinus*).—A winter visitor, though not in very great numbers.

62. House-Sparrow (*Passer domesticus*).—A common resident.

63. Tree-Sparrow (*Passer montanus*).—A scarce resident, but apparently increasing in certain localities.

64. Chaffinch (*Fringilla cœlebs*).—Resident and common.

65. Brambling (*Fringilla montifringilla*).—A visitor in immense quantities during some winters, though scarce in others. This bird seems to frequent more especially the neighbourhood of beech-trees.

66. Linnet (*Linota cannabina*).—Plentiful and resident in some localities, but becoming much scarcer towards the north of Hertfordshire.

67. Mealy Redpoll (*Linota linaria*).—One was taken on the borders of the county towards Ivinghoe by Mr. Banfield in September, 1883.

68. Lesser Redpoll (*Linota rufescens*).—A winter visitor, though apparently in small numbers. It is reported to have nested at Sopwell, near St. Albans, in the summer of 1898.

69. Twite (*Linota flavirostris*).—In December, 1883, a pair, and in February, 1884, two pairs, were caught on the borders of the county towards Aldbury, and on the 4th of May of the latter year a male was captured near Hitchin.

70. Bullfinch (*Pyrrhula europæa*).—Resident and plentiful, though much persecuted in fruit-growing districts.

71. Crossbill (*Loxia curvirostra*).—A fairly regular winter visitor to suitable localities. In the third edition of Yarrell's 'British Birds' Hertfordshire is mentioned as one of the counties in which this bird has been found nesting. In March, 1895, I observed a pair near Berkhamsted which may have been nesting.

72. Two-barred Crossbill (*Loxia bifasciata*).—The only specimen of this bird which has been obtained in this county was one which from its plumage was probably a female and which was shot at Tharbies, near Sawbridgeworth, by Mr. H. S. Rivers, on 11th January, 1890. It is now in his possession.

73. Corn-Bunting (*Emberiza miliaria*).—Resident and common, especially towards the north and north-west of the county.

74. Yellowhammer (*Emberiza citrinella*).—Resident and common.

75. Cirl-Bunting (*Emberiza cirlus*).—Scarce. A few are found on the Chalk hills to the north-west, where the species breeds sparingly.

76. Rustic Bunting (*Emberiza rustica*).—A young male was taken by a birdcatcher at Elstree on 19th November, 1882. It was stuffed by Burton, of Wardour Street, and passed into the possession of the late Lord Lilford.

77. Reed-Bunting (*Emberiza schœniclus*).—Resident and not uncommon in suitable localities.

78. Snow-Bunting (*Plectrophanes nivalis*).—In February, 1881, one, which passed into the possession of Mr. W. Hill, was shot near Hitchin, while about the same time several were seen near Royston, two of which were caught with some larks. On 24th January, 1883, one was shot on Harpenden Common, and on 27th December, 1886, and again on the 29th, a flock was seen at Marlowes, Hemel Hempstead. On 6th December, 1893, a specimen was picked up under the telegraph-wires on Royston Heath, and in January, 1894, one was shot at Sandon.

79. Starling (*Sturnus vulgaris*).—Resident and common.

80. American Red-winged Starling (*Agelæus phœniceus*).—In the first volume of the 'Transactions' of this Society there is mention of a bird of this species having been obtained near Bovingdon during the spring of 1879. This is a bird which is imported as a cage-bird into this country in some numbers, and no doubt the specimen mentioned above was an escaped example.

81. Chough (*Pyrrhocorax graculus*).—In the 'Herts Advertiser' for 21st June, 1884, appeared a letter from a Mr. Henry Cross, of Harpenden, in which he gave a description of a bird of this species which he had seen on the eastern side of the Midland Railway near Beechbottom Wood, St. Albans, on 27th May in that year. Much correspondence appeared in the papers about it, but no

evidence was forthcoming that a chough had escaped from confinement at that time, although that would seem to be the most likely solution of such an occurrence.

82. Jay (*Garrulus glandarius*).—Resident and common.

83. Magpie (*Pica rustica*).—Though no doubt at one time a common resident, this bird has now completely disappeared from those districts in which game-preserving is carried on to any extent.

84. Jackdaw (*Corvus monedula*).—Resident and common.

85. Raven (*Corvus corax*).—This bird was probably a fairly plentiful breeding-species in Hertfordshire in former times, but it has now vanished. At present I am only aware of two places where it formerly nested, although there are no doubt several others. One is in Brocket Hall Park and the other is in Beechwood Park. The late T. H. Booth, in the second edition of the catalogue of his famous museum at Brighton, stated that he was shown by Mr. Norman Thrale a tree in Brocket Hall Park where a pair of ravens had nested from time immemorial up to about 1846, and that Mr. Thrale had two specimens of the bird in his collection, which had been obtained there. With regard to the nest at Beechwood I have only the statement of a man who formerly lived at Woburn Park, and who heard a former Duke of Bedford, talking of the raven's nest there, state that the nearest nest to his knowledge was in Beechwood Park. Of late years this bird has only been a very occasional visitor; in fact, since 1880 there have only been six recorded occurrences. In 1881 a raven was seen on the outskirts of Mimms Wood on February 25th, and in 1884 a specimen was obtained near Royston on December 16th, near which place also two were seen at Church Hill Farm on 19th November, 1885. In October, 1894, one was knocked off a tree with a stone by a boy at Tring, while on December 26th a dead raven was picked up in Tring Park. In 1890 a raven is reported to have been shot in this county in January. In addition to the above instances there is in the hall at Munden a stuffed raven, which was obtained there probably between 1840 and 1850.

86. Carrion-Crow (*Corvus corone*).—This is another resident which has diminished in numbers on account of game-preserving, although it is still comparatively plentiful in the south of the county.

87. Hooded Crow (*Corvus cornix*).—A regular winter visitor. This bird takes one of its names—Royston crow—from Royston in this county.

88. Rook (*Corvus frugilegus*).—Resident and common.

89. Sky-Lark (*Alauda arvensis*).—Resident and common.

90. Wood-Lark (*Alauda arborea*).—The only record which I can find of this bird in Hertfordshire is a statement that in 1878 and 1879, during the month of March, this species was observed in a field close to Symond's Hyde Wood, in the parish of Sandridge, by Mr. A. F. Griffith, who had no doubt that it bred there.

91. Short-toed Lark (*Alauda brachydactyla*).—On 9th March,

1886, the Hon. Walter Rothschild obtained a bird of this species in Tring Park when shooting food for a tame owl, and the bird is preserved in the Tring Park collection.

92. Swift (*Cypselus apus*).—A common summer visitor.

93. Nightjar (*Caprimulgus europæus*).—A fairly plentiful summer visitor in suitable localities.

94. Wryneck (*Iynx torquilla*).—A plentiful summer visitor, though rather local.

95. Great Spotted Woodpecker (*Dendrocopus major*).—A resident, plentiful in the western and north-western parts of the county and not uncommon in other districts.

96. Lesser Spotted Woodpecker (*Dendrocopus minor*).—A not uncommon resident; prefers parks with fine old trees.

97. Green Woodpecker (*Gecinus viridis*). — Resident and plentiful.

98. Kingfisher (*Alcedo ispida*).—A fairly plentiful resident in some parts of the county, but sadly persecuted on account of its brilliant plumage.

99. Roller (*Coracias garrulus*).—On 20th September, 1852, a roller was obtained at Callipers, near Chipperfield.

100. Hoopoe (*Upupa epops*).—The late Mr. Littleboy stated that this species had been obtained on several occasions in this county, but I can only find two records of it. In May, 1882, one in fine plumage was shot in the parish of Welwyn by a keeper named Gooch, who had it preserved; and in April, 1888, one was seen at The Hoo, Gaddesden.

101. Cuckoo (*Cuculus canorus*).—A common summer visitor. The egg of this bird has been found in the nests of the following birds, amongst others, in this county:—stonechat, swallow, hedge-sparrow, wagtail, meadow-pipit, reed-warbler, whitethroat, and robin.

102. White Owl (*Strix flammea*).—Resident and fairly plentiful, though persecuted by gamekeepers.

103. Long-eared Owl (*Asio otus*).—Resident, but very local.

104. Short eared Owl (*Asio accipitrinus*).—An occasional winter visitor, sometimes in numbers.

105. Tawny Owl (*Syrnium aluco*).—A plentiful resident in wooded districts.

106. Little Owl (*Athene noctua*).—In May, 1877, a specimen of this bird was procured at Ashwell, near Royston, and in 1897 a pair, which hatched two young ones, nested in the county. I am not at liberty to state the exact locality, as my informant is afraid of the birds being disturbed, but I am quite satisfied with the evidence supplied to me. Of course it is very likely that these birds were originally turned out or were the descendants of turned-out birds, but an occurrence of this kind shows that such birds may become naturalized in a place.

107. Hen-Harrier (*Circus cyaneus*).—On 28th October, 1883, a hen-harrier was seen at Weston Manor, Stevenage, by Mr. M. R. Pryor, who was positive as to the correct identification

of the bird. On 7th November, 1897, Mrs. Brightwen's bailiff at Elstree saw a bird which he described as of this species at the Reservoir, where it remained for some days. In December, 1884, a female was shot near Tring, where another, which is now in the possession of Sir V. H. Crewe, was shot many years ago. About the year 1845 a pair of these birds were shot in the parish of Sandon and passed into the possession of the late Mr. Henry Fordham.

108. Montagu's Harrier (*Circus cineraceus*).—In 1875 one of these birds was shot at Hexton by Captain Young.

109. Buzzard (*Buteo vulgaris*).—This bird, no doubt, was formerly a fairly plentiful resident, although at the present time its visits are very few. In 1877 a buzzard was shot at Russell Farm, near Watford, while another was killed in Hatfield Park in 1879. In October, 1881, a bird of this species was seen near Royston, where one was killed on the 15th of the same month, and in February of the same year a specimen was obtained at Harpenden. About September or October, 1897, a buzzard was shot at Barrington; this is probably the bird referred to in 'The Globe' of the 9th of September in that year as having been shot in Hertfordshire, and presented to the Hertfordshire County Museum at St. Albans. In October, 1897, and again on October 7th, 1898, a buzzard was seen flying over Earlswood, near Barkway. There is also a buzzard preserved at Munden, which was shot near there many years ago.

110. Rough-legged Buzzard (*Buteo lagopus*).—On 9th November, 1880, a female of this species was shot at Bennington, and on 3rd January, 1881, one was seen at Easneye, near Ware. In 1883 another was shot at Bennington on October 30th. On 19th February, 1892, a specimen was trapped in Bishop's Wood, Rickmansworth, and was exhibited by Lord Ebury at a meeting of this Society, and in the autumn of the same year two of these birds were shot, and a third was taken alive at Tring.

111. White-tailed Eagle (*Haliaëtus albicilla*).—The late Mr. Abel Smith, M.P., had in his possession a specimen of this bird, which was shot some years prior to 1877 at Sacombe.

112. Sparrowhawk (*Accipiter nisus*). — Formerly a common resident, but now much diminished in numbers by game-preservers.

113. Kite (*Milvus ictinus*). — It is probable that this bird formerly nested in Hertfordshire. Morris mentions it as occasionally occurring in the county, but the only actual record is of one killed about 1840 near Munden, Watford, which is preserved in the collection there.

114. Honey-Buzzard (*Pernis apivorus*).—On 29th September, 1881, a honey-buzzard was shot at Westmill, near Buntingford, and on the same day another was obtained at Little Hadham. At Munden there is a bird of this species which was shot in the neighbourhood, probably between 1840 and 1850.

115. Peregrine Falcon (*Falco peregrinus*).—No doubt in days gone by Hertfordshire saw many a flight with this falcon, but nowadays nearly the only mention one sees of this fine bird in

the county is that one has been shot, and not many people have had the good fortune that I had in 1895 to see, in Hertfordshire, a peregrine stoop at a partridge. During the last twenty-five years this bird has been recorded on at least fifteen occasions, and in nearly every case it has been destroyed. The following are the various records:—1876, one shot at Hexton. 1878, a pair shot at Newnham, near Baldock. 1881, September 18th, a male shot at Stoney Hills, near Bengeo, Hertford; November 23rd, a female shot at Bramfield, near Hertford. 1891, December, a female shot at Cole Green. 1895, March 16th, a female (?) seen at Pendley Manor, Tring; August, a male captured at Croxley Green. 1896, August 6th, a female killed at Northchurch, Berkhamsted; December 20th, one shot near Elstree. 1897, September 30th, a female shot at Newnham, near Baldock; December 15th, one seen near Elstree; autumn, one seen near Royston. In addition to the above, Mr. Franklin, of Sandridge, owns one obtained near that place, another was killed at Marshall's Wick, St. Albans, by a keeper named Pangbourne, and Mr. Thrale, of No Man's Land, also had two in his possession.

116. Hobby (*Falco subbuteo*).—A hobby was shot in Hatfield Park in 1879, and in 1881 a nest of this species with four eggs was found in Moor Park. Mr. Latchmore, of Hitchin, has eggs in his possession which were taken some years ago at Stevenage. Mr. Nunn, of Royston, informed me that in 1847 this species was not uncommon in the neighbourhood of Kelshall, but that the last bird obtained in that parish, which is now in his possession, was shot off the nest by a keeper in 1849. In 1885 a hobby was shot on September 17th near Port Vale, and on 3rd July, 1887, another was shot at Cowheath Wood, near Hoddesdon, and is now in the possession of Mr. F. M. Campbell.

117. Merlin (*Falco æsalon*).—Mr. William Lucas informs me that this species has been obtained near Hitchin, but he can give no particulars. At Tring two immature birds were shot in February, 1886, and two adults were procured there in January, 1887. In December, 1896, a merlin was seen at Elstree.

118. Kestrel (*Falco tinnunculus*).—No doubt this bird was formerly a common resident in Hertfordshire, but it is now decidedly on the decrease in many parts of the county owing to the foolishness of gamekeepers.

119. Osprey (*Pandion haliaëtus*).—In September, 1864, a pair of ospreys frequented the Tring Reservoirs, and on the 30th of that month the female was shot, but the male eventually disappeared. In September, 1880, a female was shot in Hatfield Park. In 1886 two were seen at the Tring Reservoirs, and in the next year a female was captured near Great Gaddesden on September 17th. It lived in captivity for about six weeks, and was eventually preserved and passed into the possession of Mr. W. M. Sheriff, of Belsize Park, London. On the 19th of the same month an osprey was seen fishing in the River Lea, near Wheathampstead, and was shot. It proved to be a male.

120. Cormorant (*Phalacrocorax carbo*).—In November, 1878, one was shot on the Tring Reservoirs, where others were seen in October, 1880, and on 31st October, 1895. On 15th October, 1881, a young bird was picked up dead near Royston, and on 5th September, 1885, a bird of this species was seen near Watford. In March, 1886, another was shot near Park Street, St. Albans.

121. Gannet (*Sula bassana*).—In August, 1884, a bird of this species, which eventually passed into the possession of Mr. Archer, of Sandridge, was captured alive near that place, and on 29th September, 1885, a young bird was picked up, also alive, near Brocket Hall, Welwyn.

122. Common Heron (*Ardea cinerea*).—Although this bird is a common visitor to the county, there is, so far as I can ascertain, no proper heronry at all in Hertfordshire. There are, however, a few isolated nesting-places scattered about, one being at Moor Park, Rickmansworth.

123. Little Bittern (*Ardetta minuta*).—In 1840 a specimen, which went into the collection of the late F. Bond, was obtained at Elstree Reservoir, and in 1884 another was shot on October 17th near the Carthagena Weir, Broxbourne.

124. Bittern (*Botaurus stellaris*).—In 1849 a nest with four eggs was found at one of the Tring Reservoirs. One of the eggs became the property of the late Mr. Worley, and is now in the possession of Professor Newton. About 1865 a bittern was shot at Rickmansworth, and on 3rd January, 1871, one was shot at Stapleford, while another was obtained at Boxmoor within a year or two of that date. On 24th January, 1881, a specimen was procured near Hoddesdon, where another was observed in the winter of 1890–91. In 1884 two were shot at the Tring Reservoirs on November 9th, and another was taken there in December, 1894. One was shot at Orton, near Hitchin, in February, 1885, and is now in the possession of Mr. William Hill, and another was obtained near the same town in 1894.

125. Glossy Ibis (*Plegadis falcinellus*).—On 10th September, 1881, Mr. Pantia Ralli shot a bird of this species at Balls Park, near Hertford, and in November, 1887, another, which is now in the possession of the Hon. Walter Rothschild, was shot near the village of Waterford.

126. Grey Lag-Goose (*Anser cinereus*).—The only recorded example of this bird in Hertfordshire was obtained at the Tring Reservoirs in September, 1886.

127. White-fronted Goose (*Anser albifrons*).—The sole evidence I can find of the occurrence of this goose in our county is a statement by the late Captain Clarke Kennedy in his 'Birds of Berks and Bucks,' on the authority of the Rev. H. H. Crewe, that it had been observed at the Tring Reservoirs.

128. Bean Goose (*Anser segetum*).—On 15th January, 1881, a bird of this species was shot from a flock of fifteen near Royston. The Hon. A. Holland-Hibbert also has one which he shot at Munden in the winter of 1890–91.

129. Canada Goose (*Bernicla canadensis*).—This bird, which is an introduced species, has occurred in this county on one occasion. One was shot from a flock of about ten on 6th June, 1893, at Cokenach, near Barkway.

130. Whooper Swan (*Cygnus musicus*).—This bird was formerly an occasional visitor to the Tring Reservoirs, but has not occurred there in recent years. During the winter of 1875–76 a pair of these birds frequented a piece of water near Great Gaddesden, and about the end of December, 1892, thirty were seen flying over Hertford, one being eventually shot at Woodhall.

131. Mute Swan (*Cygnus olor*).—This bird, which is kept on many ornamental waters in the county, has probably never occurred in a really wild state in Hertfordshire.

132. Polish Swan (*Cygnus immutabilis*).—This doubtful species has visited the Tring Reservoirs on three occasions, viz., in August, 1885, when one was shot, and in October, 1886, when two were shot. The other time, for which no date is given, was when nine arrived there and stayed some days.

133. Sheldrake (*Tadorna cornuta*).—In 1883 Mr. Willsbin shot a specimen of this duck during Christmas week at Elstree Reservoir, where another was seen in December, 1896. At Tring a sheldrake was observed by the Hon. Walter Rothschild on 8th January, 1888, and Street saw one there on 10th January, 1897.

134. Mallard (*Anas boscas*).—Resident and common, breeding at Tring in large numbers.

135. Gadwall (*Anas strepera*).—The Rev. H. H. Crewe stated that this duck occasionally occurred at Tring in former times.

136. Shoveller (*Spatula clypeata*).—One or two pairs of this duck nest regularly at or near the Tring Reservoirs, and it has been shot on a few occasions in other parts of the county.

137. Pintail (*Dafila acuta*). — This bird formerly occurred occasionally at Tring, but in recent years only two examples have been procured there. These were a male on 14th February, 1892, and a female on 3rd October of the same year. The only other record of this duck in Hertfordshire appears to be that of a bird shot at Radwell, near Hitchin, in 1877.

138. Teal (*Querquedula crecca*). — This duck occurs in small parties nearly every year at Tring, and occasionally remains to nest there. A nest found there on 25th April, 1887, together with the parent birds, is preserved in the Natural History Museum, South Kensington. This bird has also been observed near Hitchin during the nesting season, but no further evidence is at present forthcoming that it nests there.

139. North American Summer Duck (*Aix sponsa*). — An individual of this semi-domesticated species was shot near Moor Mill, St. Albans, in December, 1891.

140. Garganey (*Querquedula circia*). — On 24th March, 1849, four males and four females were observed at the Tring Reservoirs, and some of them were eventually shot. In 1879 a garganey was shot on Easter Day on a pond at Bennington.

141. Wigeon (*Mareca penelope*).—This bird was formerly very plentiful at the Tring Reservoirs, but in recent years has only occurred there in small parties. It is occasionally seen at Elstree Reservoir, and specimens have also been obtained at various times on the River Colne.

142. Pochard (*Fuligula ferina*).—The pochard occurs in large numbers at Tring during the winter, and several pairs remain there to nest every year. It also frequently occurs in the winter on the lake at Hoddesdon.

143. Red-crested Pochard (*Fuligula rufina*).—A female of this rare duck was obtained by the Hon. Walter Rothschild at Tring in September, 1887, and is now in his collection.

144. Tufted Duck (*Fuligula cristata*).—This duck is found in large numbers at Tring during the winter, and is gradually increasing there as a breeding species. It has also been observed on several occasions at Hoddesdon. A male of this species paired with a pochard and reared young at Tring in 1887.

145. Scaup (*Fuligula marila*). — A female was shot on the Ashe, near Easneye, on 22nd January, 1881, and a specimen was obtained at Tring in October, 1884. It is said to have occurred on former occasions at this latter place, but no particulars are forthcoming.

146. Golden-eye (*Clangula glaucion*).—A male in full plumage was shot at Tring in the early part of 1849, and nearly every year immature birds and females are observed there. The late Dr. Brett stated that a pair were shot in the Bushey Meadows some years ago.

147. Long-tailed Duck (*Harelda glacialis*).—The only recorded occurrence of this bird in Hertfordshire is of a young male which was shot at Tring on 28th October, 1892.

148. Common Scoter (*Œdemia nigra*). — In February, 1881, a pair of these ducks were seen at Bushey Heath, and in October, 1884, a female was shot at the Tring Reservoirs.

149. Velvet-Scoter (*Œdemia fusca*). — The Rev. H. H. Crewe stated that this bird occurred on two occasions at Tring, but he gave no particulars.

150. Goosander (*Mergus merganser*).—The Rev. H. H. Crewe stated that he had seen this bird occasionally at Tring, and two were killed there in 1885 in the month of February. The keeper there saw two on 25th November, 1895, and two more in January, 1896. In the winter of 1890–91 one is said to have been obtained near St. Albans.

151. Red-breasted Merganser (*Mergus serrator*). — In the Munden collection there is a male and female in splendid plumage which were obtained there between 1840 and 1850.

152. Smew (*Mergus albellus*).—A female was obtained at Munden on 28th December, 1846. A flight of nine was seen at the Tring Reservoirs in February, 1885, and a female was obtained at Welwyn on 10th January, 1891. In October, 1893, a young bird was caught near Watford.

153. Ring-Dove (*Columba palumbus*).—Resident and common, appearing in immense flocks some winters.

154. Stock-Dove (*Columba œnas*).—Resident, and fairly plentiful in the more wooded districts.

155. Turtle-Dove (*Turtur communis*). — A common summer visitor.

156. Pallas' Sand-Grouse (*Syrrhaptes paradoxus*).—In 'The Zoologist,' vol. xxi, there is mention of two male sand-grouse having been shot in June, 1863, at Dugdale Hill, South Mimms, Herts. This place is actually in Middlesex, though surrounded on three sides by our county. In the same volume there is also a note of nine of these birds which were obtained near Royston. They were all females, and although not stated, no doubt some of them were shot in Hertfordshire. In 1888 two of these birds were picked up dead near Royston about the middle of May, and on the 20th of that month two were shot out of a flock of about forty at Gepps Farm, near Hoddesdon. The last-mentioned birds are in the possession of Mr. F. M. Campbell. On the 22nd of the same month Mr. A. W. Dickinson saw seven sand-grouse near Batchwood, St. Albans, and on June 4th Mr. Chapman, of Bennington, shot a sand-grouse there which is now in his possession.

157. Pheasant (*Phasianus colchicus*).—Very largely preserved on many of the estates in the county.

158. Partridge (*Perdix cinerea*).—Common. Very good partridge shooting is obtained in some parts of Hertfordshire.

159. Red-legged Partridge (*Perdix rufa*).—Plentiful in some districts.

160. Quail (*Coturnix communis*).—This bird, according to Mr. Howard Saunders, was much commoner in Hertfordshire in former times. Nowadays in some years it is fairly plentiful on the Chalk hills to the north of the county, more especially in the Royston district, where no doubt it often nests. In the rest of the county it is only of infrequent occurrence.

161. Virginian Colin (*Ortyx virginianus*).—An old female of this introduced species was shot near Stevenage on 12th August, 1882. Attempts have been made to naturalize this bird in the Eastern Counties and elsewhere, and no doubt the example above referred to was a wanderer from those districts.

162. Corn-crake (*Crex pratensis*).—A common summer visitor.

163. Spotted Crake (*Porzana maruetta*).—In 1878 one was shot in the Colne Meadows, near Watford, on September 4th, and in October, 1881, another, which is in the possession of Mr. Downer, was killed by the telegraph-wires near the same town. In October, 1880, two were picked up dead by the railway near St. Albans, and in September, 1883, one was shot at the Tring Reservoirs, where another was obtained in October, 1885. In November, 1893, a spotted crake, now in the possession of Mr. Latchmore, was killed by flying against the telegraph-wires at Hitchin, where others have been obtained from time to time,

one being procured there during the winter of 1895–96. In August, 1896, a bird of this species was picked up dead at Offley.

164. Little Crake (*Porzana parva*).—A bird of this species is said to have been obtained at one of the Tring Reservoirs on 5th January, 1887.

165. Baillon's Crake (*Porzana Bailloni*).—A specimen of Baillon's crake was shot in the marshes near Cheshunt on 24th October, 1891.

166. Water-Rail (*Rallus aquaticus*).—Not uncommon in the winter in suitable localities, and probably breeds at Tring.

167. Moor-hen (*Gallinula chloropus*).—Resident and common.

168. Coot (*Fulica atra*).—Resident and common at Tring.

169. Great Bustard (*Otis tarda*).—According to Willoughby and Ray this bird formerly frequented Royston Heath, and no doubt it was also found on the vast open fields along the north and north-west boundaries of Hertfordshire. The only other record that I can obtain of the great bustard in this county is the statement that about the beginning of this century one appeared in the neighbourhood of Royston, and that although the whole country turned out intent on its destruction, it escaped.

170. Stone-Curlew (*Œdicnemus scolopax*).—Although formerly far from scarce in the north and north-west of Hertfordshire, this species is gradually diminishing, and very few pairs are now found nesting in the county.

171. Dotterel (*Eudromius morinellus*).—This bird has greatly decreased in the numbers which visit this county on their way north and on their return journey, though small trips annually make their appearance in the district between Hitchin and Royston.

172. Ringed Plover (*Ægialitis hiaticula*).—This bird is an habitual visitor to the Tring Reservoirs at all seasons of the year, though only in small parties. It probably also visits Elstree occasionally, and it is a frequent visitor to the Royston district.

173. Golden Plover (*Charadrius pluvialis*).—An annual winter visitor, though in varying numbers.

174. Grey Plover (*Squatarola helvetica*).—A specimen was obtained at Tring in March, 1885, and in the spring of 1893 a female which had come in contact with the telegraph-wires was picked up near Royston.

175. Lapwing (*Vanellus cristatus*).—Resident. Its numbers are greatly increased in the winter.

176. Oyster-Catcher (*Hæmatopus ostralegus*).—In April, 1866, a bird of this species was shot at Elstree Reservoir, where another was shot in February, 1868. One was shot at Tring on 24th September, 1897.

177. Grey Phalarope (*Phalaropus fulicarius*).—In the seventies a grey phalarope was shot at Grove Mill, near Hitchin, by Mr. Latchmore, in whose possession it now is. In October, 1885, one was shot at the Tring Reservoirs, in 1891 four were obtained there in the same month, and another was shot at Chiltern Green in November.

178. Woodcock (*Scolopax rusticula*).—A regular winter visitor. A few pairs remain to breed in different localities, nests having been found at Tring, and near Haileybury, Hertford Heath, and Hoddesdon.

179. Great Snipe (*Gallinago major*).—This species was obtained some years ago on Bushey Heath, but I can obtain no further particulars. An albino was shot at Tring in August, 1880, and went into the Tring Park collection. The latest record is of a female which was shot on 11th September, 1897, at Slip End, Sandon, by Mr. J. H. Phillips, of Royston, in whose possession it now is.

180. Common Snipe (*Gallinago cœlestis*).—A regular winter visitor to suitable localities.

181. Jack Snipe (*Gallinago gallinula*).—A winter visitor.

182. Dunlin (*Tringa alpina*).—A regular visitor at all seasons to the Tring and Elstree Reservoirs, and it has also occasionally occurred in other parts of the county.

183. Little Stint (*Tringa minuta*).—Two of these birds are said to have been obtained at Tring in August, 1885.

184. Temminck's Stint (*Tringa Temmincki*).—A bird of this species was shot at the Tring Reservoirs in September, 1887.

185. Sanderling (*Calidris arenaria*).—An occasional visitor on migration to the Tring Reservoirs.

186. Ruff (*Machetes pugnax*).—In the Munden collection there are two ruffs and a reeve which were obtained in that neighbourhood, probably between 1840 and 1850. About 1882 a reeve, which is now in the possession of Mr. C. P. Stewart, was obtained at Chisfield, near Stevenage. In August, 1884, a ruff was shot at Tring, where two were obtained in August, 1886. In 1895, on August 17th, two of these birds were seen at Tring, and one, which turned out to be a reeve, was shot a day or two later.

187. Common Sandpiper (*Totanus hypoleucus*).—A fairly plentiful visitor on migration. In 1896 a nest was found under a high bank at the sluice-pit at Hyde Mill, near Hitchin.

188. Wood-Sandpiper (*Totanus glareola*).—One is said to have been shot at the Tring Reservoirs in August, 1886.

189. Green Sandpiper (*Totanus ochropus*). — A regular visitor on migration to the Tring Reservoirs, and also to Ickleford, near Hitchin.

190. Redshank (*Totanus calidris*). — An occasional visitor to Tring. In 1875 or 1876 a redshank was obtained in the Colne Meadows, near Watford, and in 1891 one was picked up in June on the Midland Railway between St. Albans and Radlett.

191. Greenshank (*Totanus canescens*). — A regular visitor on migration to the Tring Reservoirs. In 1880 one was shot on the Colne, near Watford.

192. Bar-tailed Godwit (*Limosa lapponica*). — In December, 1880, one was shot at Tring.

193. Black-tailed Godwit (*Limosa belgica*). — One was obtained at the Tring Reservoirs in September, 1886.

194. Curlew (*Numenius arquata*). — In 1879 several were observed in the neighbourhood of Royston. In May, 1882, a female was shot at Sacombe, and on Christmas Day of the same year the late Dr. Brett heard curlews passing over Watford. A bird of this species was shot at Tring in August, 1884, and two were shot and another was seen at Stevenage on December 4th of the same year. Since then these birds have appeared more regularly in the county, and in greater numbers, as many as sixteen having been seen together at Tring.

195. Whimbrel (*Numenius phæopus*).—A whimbrel was shot at Throcking in July, 1881, and another was procured at Buckland on 17th May, 1883.

196. Black Tern (*Hydrochelidon nigra*).—An annual visitor to Tring during the spring and autumn, as many as sixty or seventy having been seen there together in May.

197. Sandwich Tern (*Sterna cantiaca*).—In October, 1886, two birds of this species were obtained at Tring.

198. Common Tern (*Sterna fluviatilis*). — A common visitor on migration to the Tring Reservoirs, where large numbers occasionally appear, and also in a smaller degree to Elstree. In 1881 several were killed near Royston.

199. Arctic Tern (*Sterna macrura*).—In the spring of 1886 a specimen was obtained at the Tring Reservoirs.

200. Little Tern (*Sterna minuta*).—In 1882 two little terns were procured near Royston, where another was shortly afterwards picked up dead. In recent years small parties of this bird have frequently been seen at Tring.

201. Brown-headed Gull (*Larus ridibundus*). — This species occurs nearly every year at Tring. On 15th March, 1896, Mr. H. S. Rivers observed one near Sawbridgeworth.

202. Common Gull (*Larus canus*). — In 1880 a common gull was obtained near London Colney, and in the next year another was shot near Hemel Hempstead. This species now frequently visits Hertfordshire, being seen almost every year at Tring.

203. Herring-Gull (*Larus argentatus*).—In 1880 a young bird was shot at Oaklands, near St. Albans, and on 15th December, 1881, one was obtained at Bennett's End, near Hemel Hempstead. In 1882, on February 2nd, and in 1883, on January 2nd, birds of this species were obtained near Royston, where also five were seen on 1st September, 1884. On 23rd September, 1886, one was knocked down at Hemel Hempstead, on 5th September, 1887, thirty-six were seen flying over Hailey Hall, Hertford, and in 1897, on the 16th of the same month, eight were observed at Tring. The late head-keeper at Ashlyns Hall, Berkhamsted, also had an immature bird of this species in his possession, which he shot near that place in 1896.

204. Lesser Black-backed Gull (*Larus fuscus*). — This bird occasionally appears at the Tring Reservoirs. In 1897 Mr. M. R. Pryor, at various times during the autumn, saw small parties of gulls flying over Weston Manor, some of which probably belonged

to this species. At Munden there is a specimen of this bird preserved which was obtained near there many years ago.

205. Great Black-backed Gull (*Larus marinus*).—This bird is said to occasionally visit the Tring Reservoirs, but the identification seems rather doubtful.

206. Kittiwake (*Larus tridactyla*).—In January, 1885, two of these birds were shot at Tring, and in February of the same year one was picked up dead at London Colney. On 19th May, 1895, one was seen on Berkhamsted Common, and in January, 1897, a dead bird of this species was found in the Priory Gardens, Hitchin.

207. Arctic Skua (*Stercorarius crepidatus*).—An Arctic skua was shot near Stevenage on 5th November, 1881, and in 1882 another, which was afterwards presented to the Watford Library, was obtained at Langleybury.

208. Guillemot (*Uria troile*).—In November, 1882, Mr. F. Hicks shot a guillemot at Elstree and had it preserved, and on 5th April, 1888, a specimen was obtained on the Hertford Meads.

209. Little Auk (*Mergulus alle*).—In 1846 a little auk was picked up between Baldock and Royston. In 1882 one was picked up alive near Langley, about five miles from Hitchin, in December, and in 1885 one was found dead in a field near Symond's Hyde, Sandridge. On 22nd November, 1893, a specimen was found between Litlington and Royston, near the latter of which places a little auk, which is now in the possession of Mr. Nash, was found in 1894. In 1895 one was picked up at Sarratt on January 25th, and about the same time others were found near Ashwell, Hitchin, and Welwyn.

210. Puffin (*Fratercula arctica*).—In March, 1882, a puffin was picked up alive at Pirton, near Hitchin, and in April of the same year another was caught near Broxbourne, and a third was picked up at Preston, near Hitchin, in the following November. A specimen of this bird was found in 1883 at Reed, near Royston, and in 1884 one was found at Munden. In the winter of 1890–91 an example was obtained near Totteridge, and at the end of 1893 one was shot at Roxford Farm, Bayfordbury. On 15th November, 1894, a puffin was picked up near St. Albans.

211. Great Northern Diver (*Colymbus glacialis*).—In December, 1841, an immature specimen was obtained at Tring, where one was shot on 1st January, 1887, and another seen on February 15th. Another is also said to have been seen there on 12th January, 1897. At Elstree specimens were obtained on 26th December, 1876, and in 1884.

212. Great Crested Grebe (*Podicipes cristatus*).—This species breeds in considerable numbers at the Tring Reservoirs, where it arrives usually about the beginning of March and leaves again in November.

213. Red-necked Grebe (*Podicipes griseigena*).—The Rev. H. H. Crewe stated that this bird had once been obtained at Tring, but gave no further particulars.

214. Slavonian Grebe (*Podicipes auritus*).—In 1881 one was shot at Radwell, near Hitchin, in January, and another was caught in Sir Astley Cooper's park at Hemel Hempstead in March, 1884. Two were shot at the Tring Reservoirs in October, 1884.

215. Little Grebe (*Podicipes fluviatilis*).—Breeds commonly on several of the small rivers in the county.

216. Storm-Petrel (*Procellaria pelagica*).—On 15th December, 1881, a male and female were picked up dead near East Lodge, Hemel Hempstead, and on 11th December, 1886, one was captured alive near the Midland Railway not far from St. Albans.

XI.

ORNITHOLOGICAL NOTES.

Read at Watford, 28th March, 1899.

Wagtails feeding a young Cuckoo.—I was much interested in a young cuckoo last summer. Outside my bedroom window, where Virginia creeper grows, I noticed two little wagtails going and coming. On looking out I discovered a nest, and in it was a young cuckoo partly fledged. He looked very fierce. One morning I missed him, but from the noise he made I traced him to a tree on the lawn. I saw the two little wagtails go and feed him. He then left that tree and went from one to another. On returning home at the end of August I still found him flying about and the little birds waiting on him. Towards the end of September he disappeared.—*Jessie R. Carew* [*Mrs. Russell Carew*], *Carpenders, Watford.*

Curious Nesting-places.—At the Station Lodge, Hatfield Park, a water-can was left hanging on a wall last season, and this spring a pair of robins chose it for their nesting-place, and although it is near a garden-path they made their nest in it and now have five young birds hatched. The Lodge-keeper is careful that the birds are not disturbed.—'*Herts Mercury*,' 21st May, 1898.

A firetail [redstart] has built its nest and is rearing its young in a watering-can which is hanging on the wall of the wash-house at Mrs. Knight's, at Potter's Heath, Codicote. There are continually persons passing by the nest, but this does not appear to disturb the birds in the least.—'*Herts Mercury*,' 18th June, 1898.

XII.

REPORT ON THE MYCETOZOA OF THE SOUTH MIDLANDS FOR THE YEARS 1895 TO 1898.

By James Saunders.

Read at Watford, 28th March, 1899.

How the development of the Myectozoa is affected by varying climatal conditions in successive seasons is well worthy of notice, and has been aptly exemplified in the years now under review.

In the early part of the year 1895 occurred the great frost of many weeks' duration which has been recorded in our 'Transactions' by Mr. Hopkinson. (See Vol. IX, pp. 89 and 228.) Just before the commencement of this frost the writer observed a large mass of plasmodium of *Badhamia utricularis* on a decayed oak log in Birchin Grove Wood, Flamstead, Herts. It was then streaming in large veins over the sheltered side of the log, that is, the side turned from the sun, being the most moist, and was evidently in full vigour. Two or three days after this the frost set in, and no observations were made until its cessation. The thaw commenced on a Thursday towards the end of February, and on the following Sunday afternoon a visit was made to the spot to note the behaviour of the plasmodium. It was found that the whole mass had become encysted when the frost commenced, forming a wax-like substance known as "sclerotium." In this condition it had withstood the excessive cold, and, in the three days subsequent to the commencement of the thaw, the largest portion had reassumed its plastic condition and was again streaming out in its characteristic veins and fans. A small portion of the sclerotium still remained unrevived, being in the highest and driest position on the log. A gathering of the plasmodium was made, which after a few weeks' cultivation fruited satisfactorily.

As a further illustration of the tenacity of life of the sclerotium-stage of *Badhamia utricularis*, the writer may mention that he has a lantern-slide of this species which was gathered in the plasmodium condition in Birchin Grove Wood in November, 1894, and was allowed to encyst itself and then kept as sclerotium until November, 1896; and that after these two years of suspended animation it was easily revived by moisture and moderate warmth, when it spread itself out into its characteristic forms in search of food. It was then rapidly dried by artificial heat, so that its usual appearance in the creeping stage should be rendered permanent.

The autumn of 1896 was excessively wet, the mean rainfall in Hertfordshire in September being 6·51 inches, and in October 3·46 inches, these two months having together more than half as much rain as fell in a whole year in 1887 and 1898. As a consequence, all accumulations of refuse vegetation, such as leaf heaps and straw heaps, were saturated in the autumn, and continued so, at least in the lower parts of such masses, during the ensuing

winter and spring. As the winter was mild also, they became veritable forcing-beds for several forms of Mycetozoa. In April, 1897, when searching for Mycetozoa at Caddington and Chaul End, on the borders of Beds and Herts, my attention was arrested by some straw heaps on a deserted farm. They were found to be teeming with unusual forms of these organisms. Encouraged by this unexpected success, straw heaps became the objects of special search during the ensuing summer, and they have yielded interesting results. The following are the most noteworthy species thus collected. Unless otherwise stated, the records are original.

Physarum straminipes, sp. nov. (Lister, 'Journ. Bot.,' vol. xxxvi, p. 163).—First found on the 2nd of May, 1897, on damp straw at Chaul End, near Dunstable; afterwards by Mr. C. Crouch on dead leaves in a dry ditch at Polluxhill, Beds.

Physarum didermoides, Rost.—Found by Mr. Crouch on a heap of stable manure at Mead Hook Farm, near Polluxhill, in October, 1897.

P. didermoides, var. *lividum*, var. nov. (Lister, 'Journ. Bot.,' vol. xxxvi, p. 161).—Discovered in April, 1897, on the same spot as *P. straminipes*, and afterwards found at Barton, Nether Crawley, and Maiden Common, Beds.

Physarum vernum, Somm.—Found by the writer and Mr. Crouch on damp straw in the neighbourhood of Luton and Ampthill, Beds, in 1897, being the first British record. Also found by Mr. E. Saunders, at Bedford, in 1898.

Badhamia ovispora, Racib.—Discovered by Mr. Edgar Saunders on old straw at Barton, Beds, on the 5th of June, 1897, being the first European record. Afterwards found among straw heaps at Stopsley Common, Beds, and Ivinghoe, Bucks.

Didymium Trochus, sp. nov. (Lister, 'Journ. Bot.,' vol. xxxvi, p. 164).—Discovered by Mr. Lister on straw at Chaul End on the 6th of May, 1897, and found by the writer in a stack-yard at Barton on the 8th of July, and by Mr. Crouch "on a heap of turnips and haulm" at Kitchen End, near Ampthill.

In addition to these, *Lycogala flavo-fuscum*, Rost, a very rare species, was detected by Mr. Crouch at the base of a decaying elm-tree at Kitchen End, Beds, in September, 1895, this being the first British record; and *Dichæa subsessilis*, Peck., was found by Miss Lister on dead bramble leaves and stems in Flitwick Wood, Beds, on the 8th of September, 1896, being the first European record. *Trichia botrytis*, var. *munda*, var. nov. (Lister, 'Journ. Bot.,' vol. xxxv, p. 217), found at Pepperstock, Herts, must be credited to 1894.

The dry periods in 1897 and 1898 have apparently checked the development of the Mycetozoa, for, although there has been no diminution in the assiduity of our searches for these organisms, nothing of special note has rewarded our efforts lately. Up to the present, 1897 may be regarded as a record year for the occurrence of unusual forms of these creatures in the South Midlands.

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ADDRESS.

GEOLOGICAL AND OTHER WORK IN HERTFORDSHIRE.

By the President, William Whitaker, B.A., F.R.S.,
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Delivered at the Anniversary Meeting, 28th February, 1899.

Ladies and Gentlemen,—

Before taking up the subject of my Address, I may add a note to that of last year, which was unfortunately too late for insertion as a postscript. The subject has been treated in some detail by Mr. Hopkinson, but my note may be acceptable as a supplement.

The unexpected has certainly an uncomfortable habit of happening, and I must own to feeling some surprise on hearing, in September, that the Chadwell Spring had entirely failed as a source of supply by overflow. Water was, however, pumped up from it later on.

I took the first chance of visiting the place, and was there on the 24th of September, with Mr. Hopkinson, being joined afterwards by Mr. Francis, Engineer to the New River Company.

The water in the spring seems to have gradually sunk until it got below the level of that in the New River. Consequently, instead of the water from the spring flowing in its accustomed course along a short conduit north-eastward to the New River, a flow was set up in the reverse direction.

Of course this was at once stopped by a temporary dam across the conduit. The spring continued to get lower, and at our visit its water was about 6½ feet below that in the conduit. It must be noted, however, that the conduit is an artificial stream, and that its water-level is above that of the natural river.

Things have been so artificialized in this neighbourhood, however, that such a thing as a natural stream cannot be found. So far as I could tell, the nearest approach to this, the Manifold Ditch (where it exists), has its water some 3 feet lower than that of the New River. We are therefore faced with the fact that Chadwell Spring was some 3 feet or more below the level of the natural Lea.

The spring was not dry; for we saw a diver go down into it; but all the bottom part that was bare was thickly coated with mud, which also appeared along the southern border, and I cannot but think that this deposit has not, at all events, improved the flow from the spring, or rather set of springs.

A powerful centrifugal pump was fixed in order to pump water out of the spring as much as possible and to clean out the basin, a process that should be watched with interest.

The basin is artificialized to such an extent that one cannot get a section of the beds passed through by it; but a cutting in the conduit near by, made for building a permanent sluice, showed 2½ feet of made ground and then alluvial silt, partly peaty, to the depth of 7 feet, this bed not being pierced at that depth.

I imagine that the various water-channels of the neighbourhood, including, let us hope, that of the Hertford sewage, are pretty well puddled, so that water does not leak out of them.

Soon after our visit Mr. Francis and Mr. Hopkinson successively visited Arkley Hole, where they found a somewhat similar state of things. The water in the spring was about 2½ feet below the outlet, so that there was no flow. The part of the basin above the present water-level was thickly covered with mud, as at Chadwell.

It is to be hoped that we may have other records of exceptional water-levels following on the past dry season.

It has occurred to me that it may be well for a Society like ours at times to take stock of what has been done for our county outside our own body. I have, therefore, looked back for a few years through such scientific literature as was easily accessible, so as to notice papers referring to Hertfordshire. That the result is almost wholly expressed in geologic terms is only natural, as the literature of other sciences comes more rarely before me: nor is this a disadvantage, for, were I to ramble over a wide field of science, I should need to go on addressing you for too long a time. Moreover, it is only fair to the disciples of other sciences that they should be left to preach on their own particular matters of faith.

It was needful, too, that I should fix a time-limit to my retrogression, and the year 1890 was chosen, for three not very good reasons: that one must begin somewhere, that it seems convenient to restrict ourselves to the Nineties, and that thereby I avoid having to notice a somewhat bulky work of my own, which was born in 1889. There are four papers which need not be noticed, as three of them have been reprinted in our 'Transactions,'* and the other has been brought to our notice by Mr. Gibbs.†

* Evans, Sir J.: "An Ancient British Coin found near Watford" ('Transactions,' Vol. IX, Pt. 4, pp. 133, 134); and "Some Roman Coins found at Brickendonbury" ('Transactions,' Vol. IX, Pt. 5, pp. 169–174, Pl. IV). Reid, C.: "Palæolithic Deposits at Hitchin" ('Transactions,' Vol. X, Pt. 1, pp. 14–22).

† Christy: "*Primula elatior* in Britain: Its Distribution, Peculiarities, Hybrids, and Allies" ('Journ. Linn. Soc.,' vol. xxxiii, no. 229, p. 172, pl ii, 1897).

It may be said that, from a geologic standpoint, I ought to have taken up the tale from 1883, to which year Mr. Hopkinson gave us a continuation of Hertfordshire Geological Bibliography. Perhaps to get over this gap and to save a breach of continuity, he may some time add a geologic bibliography from 1883 to 1889, from outside sources. I leave the matter in his hands, and at once go on to 1890, so that we may get a fuller notion of what has been done for us from that year until now.

1890.

In part ii of his paper on the Westleton Beds, Sir J. Prestwich referred to the probable range of that pebbly gravel into Hertfordshire,* between Hatfield and Hertford Heath, at Bernard's Heath, Collier's End, Sacombe Green, near Welwyn, at Ayot and Burnham Green, Bennett's End, etc., all on high ground.

Dr. F. H. Blaxall, in a Report to the Local Government Board, remarked that "the sewerage of the town [of Berkhamsted] . . . is of most defective character, giving rise to nuisances that are everywhere prevalent," and adding, "nor is mischief from the present condition of the Berkhampstead sewers limited to the town itself, for the stream empties into the canal at the east end of the town, polluting its waters with foul and dangerous sewage."†

This severe criticism of what is, let us hope, a past state of things, is of value, as showing that there have been faults in Hertfordshire, and that such faults are liable to be found out.

1891.

In a paper "On some Hill Gravels North of the Thames," Mr. H. W. Monckton and Mr. R. S. Herries refer to the Westleton Beds in Hertfordshire, and describe sections in the Tertiary district between Hatfield, Hertford, and Barnet,‡ which had not been previously described.

In the "Handbook of the London Geological Field Class" of Prof. H. G. Seeley there is a note of an excursion to Boxmoor, with chemical analyses of the Chalk Rock.§

A very useful publication of this year was issued by the Geologists' Association; "A Record of Excursions made Between 1860 and 1890," in which will be found accounts of excursions made before our Society was invented. Hertfordshire is treated of on pp. 149–173.‖

* 'Quart. Journ. Geol. Soc.,' vol. xlvi, pp. 137–139, 145, 149, 150, pl. vii; and pl. viii (with part iii), 1890.

† "Report . . . . upon an outbreak of Diphtheria at Berkhampstead." Fol. London.

‡ 'Proc. Geol. Assoc.,' vol. xii, pt. 4, pp. 111, 112.

§ 8vo. London. pp. 120, 121.

‖ 8vo. London. pp. vii, 571.

In a Report to the London County Council "on the Possibility of obtaining a Supply of Water for London within the Thames Basin," the supply already got from Hertfordshire was noticed by Prof. A. H. Green and myself, but we did not suggest any extension thereof. *

The Report, by Mr. (now Sir) A. R. Binnie, "On the London Water Supply from the Thames and Lea," is clearly of importance to Hertfordshire, the character of the Valley of the Lea and the quantity of water taken from that river being specially treated. †

A paper, by Mr. J. T. Harrison, "On the Subterranean Water in the Chalk Formation of the Upper Thames" gave rise to a long discussion. Sir H. Gilbert referred to the percolation-experiments, rainfall, etc., at Rothamsted, giving elaborate tables; Mr. Hopkinson took up the tale of rainfall, etc., for the county generally; Sir J. Evans drew attention to various matters connected with water in the Herts Chalk, and, in his reply, the author also treated of this subject. ‡

In this year there was issued a Revised Edition of the Drift Map, Sheet 46, N.E. of the Geological Survey (Baldock and Hitchin), based on work done on the six-inch maps.

1892.

Mr. E. T. Newton described an Iguanodont Tooth from the Lower Chalk (Totternhoe Stone) near Hitchin, which is "of later date than any British Dinosaurian remains hitherto recorded." It is provisionally named *Iguanodon Hillii*, after our member, Mr. W. Hill. §

In a pamphlet entitled "The Supply of Water to London in the Near and the Distant Future," Prof. J. L. Lobley makes much reference to the Hertfordshire sources. ‖

Mr. J. W. Grover, in his paper "An Explanation of the London Water Question," advocated taking water from the Valley of the Colne. ¶

A Report to the London County Council, by Mr. H. L. Cripps, on "The Position of the London Water Companies," contains much matter concerning our county, the powers of the Companies to take water from the Lea (pp. 87–93) and from wells being treated of,

* 8vo. London. Printed, but not published. pp. 13–15.
† Ibid., pp. 22–25.
‡ 'Proc. Inst. Civ. Eng.,' vol. cv, pt. iii. The following pages refer to Herts: 31–52, 60, 61, 82–84.
§ 'Geol. Mag.,' dec. iii, vol. ix, pp. 49, 50.
‖ 8vo. London. p. 32.
¶ 'Trans. Surveyors' Inst.,' vol. xxiv, pt. vii, pp. 214–219.

besides various other matters, and the original Charter of the New River Company being reprinted in Appendix D. *

1893.

In a paper on disseminated silica in chalk Mr. JUKES-BROWNE gives a chemical analysis (by Prof. HARRISON) of Middle Chalk from Hitchin, showing ·35 per cent. of colloid silica. †

In this year the Geologists' Association seems to have had an excursion into Hertfordshire in which our Society did not take part. It was to Amwell and Chadwell Springs, and the account of it refers also to the Ware boring and to other works of the New River Co. ‡

Sir J. EVANS treated of "Hertfordshire and its Water Supply," drawing attention to the amount already taken from the Valley of the Lea, and to the Hertfordshire case against the extension of the supply of the New River and East London Companies from wells in that valley. §

A Report of my own, to the Ware Local Board of Health, on the water-supply of the town, was printed in a local newspaper in June.

An Address, by Mr. W. A. M. VALON, contains a notice of the Barnet water-supply and of the Mimms swallow-holes. ‖

The most important work of this year, as regards Hertfordshire, is in the form of a Blue Book, detailing the proceedings of "the Royal Commission appointed to inquire into the Water Supply of the Metropolis," which is generally known as the Balfour Commission, from its Chairman, Lord Balfour. ¶ Unfortunately, such publications are not generally found in public libraries, and the valuable information contained in them is less widely known than it should be.

The Report deals with "Deep Wells" and with "the Chalk as a Water-bearing Formation" at some length.

Of the Plans, etc., several refer to Herts, and Mr. R. E. MIDDLETON's water-contour Map is wholly concerned with our county.

The volume of "Evidence" contains much relating to Herts, but it would be a lengthy task to give full references, and I must be content with referring more especially to the evidence given by the following, with pages:—J. FRANCIS (2, 16, 102, 197);

* 8vo. London. pp. x, 134, 151.
† 'Geol. Mag.,' dec. iii, vol. x, pp. 543, 4.
‡ W. Topley. 'Proc. Geol. Assoc.,' vol. xiii, pt. 5, pp. 123–5.
§ 'Hertfordshire Illustrated Review,' No. 1.
‖ 'Trans. Soc. Eng.'
¶ Folio. London. Consisting of Report, Maps, Plans and Diagrams, Minutes of Evidence, Appendices to Minutes of Evidence, and General Index.

W. B. Bryan (17, 103, 199, 467); Prof. W. B. Dawkins (33); W. Topley (37, 313); Major L. Flower (39, 43, 216); J. Child (48, 218); W. C. Young (49); Dr. G. Turner (169, 250); W. J. Dibdin (191); Dr. T. Stevenson (246); C. E. Longmore (248); U. A. Smith (252, 308); T. Hawksley (257); B. Latham (276); J. Hopkinson (304); Myself (349); Sir J. Evans (367); C. Docwra (375).

Turning to the volume of "Appendices" we have first the statements supplied by the New River and East London Companies, describing their supplies. Then the statements of the Lea Conservancy (114) and of W. C. Young (126), with many analyses of waters. J. G. Symons treats of the Rainfall over the Watershed of the Lea (175). Dr. A. Ashby notes the pollutions along the Colne and its tributaries (183). Dr. G. Turner reports similarly on the Lea and its tributaries (197). Dr. E. Frankland gives a number of analyses of Lea water (201). W. J. Dibdin gives analyses of New River water from the intake near Hertford (244), of waters of the Lea and of its tributaries (266, 294, 322), and of various sewages (272, 330). C. E. Longmore, Dr. T. Stevenson, Dr. G. Turner, and U. A. Smith treat of the Hertford sewage and of its effluent (336, 337, 342, 345); but I must beg leave to differ with them as to the latter liquid, of the nastiness of which I have had personal experience: it is a disgrace to the county. J. Hopkinson gives a long account of "Hertfordshire Rainfall, Percolation, and Evaporation" (374),* and is followed by U. A. Smith with a statement on behalf of the Herts County Council, dealing with abstraction of water from the Chalk, condition of rivers and springs, cause of decreased flow, flow of the Lea, yield of Chadwell Spring, particulars of various rivers, springs, and wells (389). W. Topley gives measurements of the areas of the various geologic formations (folding table, opp. p. 414), a most valuable piece of work, arranged by river-basins. Prof. W. B. Dawkins treats of supplemental supplies from wells, with several references to Herts (419). My "Memorandum on Swallow-holes" also refers to the county (431), and Sir J. Evans discusses percolation, etc. (441). A Report, by R. E. Middleton, "on an Inquiry into the Alleged Depletion of Rivers, Springs, and Wells in Hertfordshire," ranges from p. 540 to p. 675, and may be briefly described as in contravention of the statements by Mr. U. A. Smith and others on behalf of the county, the author thinking "that there is no proof of any permanent depletion of any river, well, or spring, except from local causes." Although several matters, more or less concerning

* Reprinted in 'Trans. Herts Nat. Hist. Soc.,' vol. ix, pp. 33-72.

the county, have not been noticed, the above is enough to show the great importance of this elaborate publication to Hertfordshire.

1894.

A detailed account of the two deep borings near Ware and at Cheshunt was given by Mr. Jukes-Browne and myself, with a good deal of new information, enabling us to correct and add to previous accounts, and referring to the subject of the old underground rocks of South-Eastern England generally.*

Although Mr. W. F. Hume's paper, "The Genesis of the Chalk," is of a general character, it refers to those divisions which are well marked in our county. †

1895.

In their paper "On the Occurrence of Radiolaria in Chalk," ‡ Messrs. W. Hill and A. J. Jukes-Browne note localities (near Hitchin and near Tring) where calcitic replacements of radiolaria occur in the nodular parts of the Melbourn Rock, the dividing bed between the Middle and Lower Chalk, and describe specimens.

Sir J. Prestwich re-issued his "Geological Inquiry respecting the Water-bearing Strata of the Country around London," for the purpose of introducing some preliminary remarks, called for by discoveries made since this important book was published, in 1851. §

The Geological Survey published Sheet 12 of its Index Map (on the scale of four miles to an inch), which includes the whole of Hertfordshire, with the greater part of the London Basin and nearly all the Weald. Whilst the hand-coloured edition of this map costs ten shillings, the almost equally good colour-printed one is only a quarter of that price, bringing a capital geologic map of important districts within the means of all who need it. An issue of 500 copies was soon exhausted, and the success of the experiment with this sheet led to all the other sheets being issued in like manner.

1896.

Mr. A. E. Salter, in a paper entitled "Pebbly Gravel from Goring Gap to the Norfolk Coast," classes the high-level gravels in five groups, according to their composition. Of these the Barnet Gate type occurs in Herts, though the locality, Newgate Street, is wrongly put into Middlesex: other localities, Barnet Gate and

* 'Quart. Journ. Geol. Soc.,' vol. l, pp. 501–513.
† 'Proc. Geol. Assoc.,' vol. xiii, pt. 7, pp. 211–246.
‡ 'Quart. Journ. Geol. Soc.,' vol. li, pp. 602, 605–8, pl. xxii.
§ 8vo. London. The new pages are pp. iii–ix.

Stanmore, are on the county-border. The Hampstead type occurs at Totteridge; the High Barnet type at that place, Potter's Bar, near Ayot, Sacombe Park, and Collier's End; the Bell Bar type at Bayford and Hertford Heath; high-level glacial gravels at St. Albans, Ayot, Welwyn, etc.

I must refer the reader to the original for the differences of character of the first four types of pebbly gravel and for their relation to the various gaps in the high ground north-east from Goring, the Hitchin and Bishop's Stortford gaps being in our domain. It is in the neighbourhood of the gaps that the gravels occur. The author regards them as "the first deposits of the Glacial Series." *

Mr. Salter showed some of these gravels to the Geologists' Association in an excursion to Potter's Bar and Hatfield. †

Mr. R. E. Middleton's paper on "The Relative Value of Percolation Gauges" is, of course, largely concerned with our county, and the conclusion come to is "that percolation gauges do afford a general indication of the amount of rain-water which passes into the subsoil under given conditions, but that the discrepancies between gauges are so marked that no one gauge can be relied on as an authoritative index of what has taken place in the whole of the district, . . . a result obtained from the averages of all the gauges is more to be relied upon"; and the gaugings of rivers should also be taken into account. In the discussion Sir J. Evans and Mr. B. Latham took a leading part. ‡

In a discourse on "The Past, Present, and Future Water Supply of London," Sir E. Frankland notices the supply from the Lea, and advocates its extension to the amount of a hundred million gallons a day, a figure which late events lead us to think much too high. §

1897.

Mr. Henry Woods has written an important paper, in two parts, on "The Mollusca of the Chalk Rock," ‖ which is largely concerned with specimens from Hertfordshire and Bedfordshire, the aid of our members, Mr. W. Hill, Dr. Morison, and Mr. J. Saunders, being duly acknowledged.

Some of Mr. Woods' remarks may well be quoted, as they should find a place in our 'Transactions.'

* 'Proc. Geol. Assoc.,' vol. xiv, pt. 9, pp. 389–404.
† Ibid., pp. 420, 421.
‡ 'Trans. Soc. Eng.,' pp. 153, etc.
§ 'Proc. Roy. Inst.,' vol. xv, p. 73.
‖ 'Quart. Journ. Geol. Soc.,' vol. lii, pp. 68–98, pls. ii–iv (1896); and vol. liii, pp. 377–404, pls. xxvii, xxviii.

"The most striking and interesting feature of the Chalk Rock is its palæontology; in the first place, fossils are very much more abundant in it than in the overlying and underlying beds, and, secondly, the general facies of the fauna is peculiar, owing to the presence of genera and species not found in the other zones of the Upper and Middle Chalk, and also to the abundance of certain groups, especially the cephalopoda and gasteropoda, which are comparatively rare in the beds just above and below. As a whole the fauna presents a much greater resemblance to that of the Lower Cenomanian [Lower Chalk, or Chalk Marl] than to any which occur in the divisions of the Senonian [Upper Chalk] and Turonian [Middle Chalk] above and below it; and whereas the latter are of a deep-water type, that found in the Chalk Rock is certainly of a comparatively shallow-water character."

When Mr. Woods says that in my first description of the Chalk Rock I "regarded it as occurring between the Upper and Lower Chalk," instead of between the Upper and Middle Chalk, he apparently forgets that at the time Middle Chalk had not been invented, that division then being merged with the Lower Chalk.

He suggests that, on account of its marked palæontologic characters, the Chalk Rock should have a zonal name, and is inclined to propose that of the "zone of *Heteroceras Reussianum*," or "*Reussianum*-zone." For my own part, I much prefer the simple English term, not because I was godfather, but because I like plain English, and also because, judging from what is constantly happening, palæontologists will in all likelihood some day change the name of *Heteroceras Reussianum* into something totally different.

In the first part of the paper the Cephalopods and the Gasteropods are described in detail, and a table of the range of the species, both in England and abroad, is given, Hitchin figuring as one of seven localities from which fossils have been recorded in quantity.

The second part deals with the Bivalves in like detail, but Hertfordshire does not find a place in the five English localities noted in the table. The "Distribution and Relations of the Fauna" are then treated of, but this lies to a great extent far beyond our border. A list of the species of Mollusca confined to the Chalk Rock in England is given; the most noteworthy points in the Mollusca are noticed, such as the rarity of Astreidæ, Pectinidæ, and Limnæidæ amongst Bivalves, and the absence of Crustacea (except Pollicipes); and a list of the fossils other than the Mollusca is added. The "Conditions under which the Chalk Rock was Deposited" are then considered at some length, the conclusion

being "that the Chalk Rock was laid down between the depths of about 100 and 500 fathoms, . . . probably . . . somewhat nearer the former than the latter limit, although the depth must necessarily have varied in different places."

We have to be thankful for the appearance of the second edition of that great work, by our esteemed member, Sir J. Evans, "The Ancient Stone Implements, Weapons, and Ornaments of Great Britain." * We are interested in the general descriptions of the various kinds of implements and in the remarks on the antiquity and origin of the River Drift, on the formation of valleys, on the climate of the Palæolithic Period, and on the fauna with which Palæolithic implements are associated.

Over forty localities in Hertfordshire are noted in the Topographical Index. A Palæolithic implement from Hitchin is figured on p. 537, and another, from Wheathampstead, on p. 601.

I am glad to call your attention, as I have called the attention of other folk, to an interesting Geological Survey Memoir, by Mr. H. B. Woodward, entitled "Soils and Sub-soils from a Sanitary Point of View; with especial reference to London and its Neighbourhood." As it includes within its scope the southern part of our county, up to St. Albans, I can the more readily advise our members to acquire it. They will see from it the importance of geologic considerations in many matters of every-day life, and they are sure to be pleased with the capital coloured map, in which the ordinary stratigraphic arrangement is subordinated to one governed by the character of the beds.

After the inevitable Introduction, with its geology, the soils and subsoils are described, gravels and sands being grouped together, then mixed soils, and then clays. The subjects of sites for houses, of water-supply and drainage, of general sanitary considerations (meteorologic especially), and of cemeteries, are treated of, and an Index of a most ingenious kind winds up the work, giving not only the pages where places are referred to, but also the principal heights of places, and, by means of a series of letters, the geologic formations.

Mr. A. Royle, in a "Report to the Local Government Board on Prevalence of Diphtheria in Watford and Bushey," notes the following facts:—

(p. 2) "As regards the older dwellings many drains were found to be defective, allowing drain air to escape into the dwellings."

"The town of Watford is supplied by the Urban District Council's Waterworks with water obtained from deep wells sunk in the Chalk."

* pp. xviii, 747, two folding plates. 8vo. London.

"This water is free from organic impurity, but is hard."

"The supply is intermittent, and amounts to 36 gallons per head per diem."

"The New Bushey portion of the town is supplied by the Colne Valley Waterworks with water also from deep wells in the Chalk, but softened before distribution."

(p. 3) Speaking of Bushey, we are told that "There are a large number of cesspools in use in the parish," and that "there are still thirty-two houses in the part of the parish next Watford not supplied by the waterworks; most of these houses have their own wells, some of which are not above suspicion of being liable to contamination."

(p. 5) "At Bushey the general dampness of the soil and the damp, dirty, ill-ventilated dwellings probably predispose persons resident in them to attacks of diphtheria."

(p. 6) "There were no circumstances that cast any suspicion on the water supply as a source of infection."

At the end of his paper "On the Origin of the High-level Gravel with Triassic Debris adjoining the Valley of the Upper Thames," Mr. H. J. O. White refers to the masses of gravel and sand along the Tertiary escarpment by Rickmansworth and Hatfield, and concludes that their constituents have been introduced by a "stream flowing from the Midlands into the synclinal trough of the London Basin through some channel corresponding to, but lying at a considerable distance to the north-east of, the Goring Gorge." *

Dr. A. Irving has given an account of an excursion to Bishop's Stortford, noticing the Chalk, the older Tertiary beds, and more especially the Drift, besides the Hertfordshire Pudding-stone. †

In a general paper, "The Chalky Boulder-clay and the Glacial Phenomena of the Western-Midland Counties of England," Mr. H. B. Woodward occasionally refers to Hertfordshire. ‡

Mr. F. Chapman published a paper on "Ostracoda from the Chara-marl of Hitchin." That fresh-water bed, which is remarkably rich in these microscopic forms, is a calcareous loam and comes between a gravel below and a brickearth above. Fifteen forms are noticed, several being figured. §

In an Address to the Sanitary Institute, I alluded to the outbreak of the Hertfordshire Bourne, contrasting its lateness, as compared with the outflow in the Kenley Valley, Surrey; but

* 'Proc. Geol. Assoc.,' vol. xv, pt. 4, p. 174.
† Ibid., pt. 5, pp. 193–196.
‡ 'Geol. Mag.,' dec. iv, vol. iv, pp. 485–497.
§ 'Ann. Mag. Nat. Hist.,' ser. vi, vol. xix, pp. 591–7, pl. xv.

this has been duly noticed in an account of our excursion to the Bourne. I ventured also to object to the Lea being under a separate Conservancy from the Thames, the former river being a tributary of the latter. *

1898.

Dr. Irving's paper "On the Geology of the Stort Valley . . . with Special Reference to the Plateau Gravels" adds to and amplifies the notice already mentioned. He describes the Ancient Stort Channel, by means of well-sections showing considerable depth to the Chalk, with details of a new well. The stratified high-level gravels are described and their origin is referred to rivers. The junction-plane of the Chalk and the Tertiaries is treated of, and it is inferred that the pudding-stones may be the remains of Bagshot Pebble Beds, though why, in this district, they should not (partly, at all events) be referred to the Reading Beds, I do not see.†

Returning to his subject of 1896, Mr. A. E. Salter treats of "Pebbly and other Gravels in Southern England," and refers to those of the Hitchin and Bishop's Stortford Gaps. ‡

An excursion to Ayot Green and Hatfield Hyde will presumably have some notice in our Proceedings, as a certain J. Hopkinson was one of its directors, and therefore one may pass it by. §

In a paper "On some High-level Gravels in Berkshire and Oxfordshire," Mr. O. A. Shrubsole has gone somewhat beyond those counties. He gives the composition of a gravel at Merrill Hill, Hatfield, which consists mainly of flint-pebbles and of quartz-pebbles, and which he classes with his Quartzose Gravel. ‖

Some "Memoranda chiefly on the Drift Deposits," by the late Sir J. Prestwich, contain short references to the Mimms Swallow-holes (1855), to Drift at Hitchin (1850), and to sections near Bushey and Aldenham (1851), from the note-books of that great geologist. ¶

1898, 9.

'The Builder' has started a set of articles on "Water Supply from the Chalk," of which two have appeared.** The first of these is of a general character, but refers to Hertfordshire. The second is more especially concerned with our county, and I cannot forbear

* 'Trans. San. Inst.,' vol. xviii, pp. 305, 312.
† 'Proc. Geol. Assoc.,' vol. xv, pt. 6, pp. 224–237.
‡ Ibid., pt. 7, p. 274.
§ Ibid., pt. 8, pp. 308–310.
‖ 'Quart. Journ. Geol. Soc.,' vol. liv, p. 588.
¶ Edited by H. B. Woodward, 'Geol. Mag.,' dec. iv, vol. v, pp. 408, 409.
** Vol. lxxv (1898), pp. 545–547; vol. lxxvi (1899), pp. 29–36.

from making two quotations from it. We are told that, "Owing to local irregularities, the London clay may rest directly on the chalk." I can only say that I have never seen such a thing, or heard of any evidence of it.

"The New River Company has captured the whole of the Chadwell spring, which rises from the chalk at Amwell, near Hertford. The flow of this spring is very variable, according to seasons of drought, which seems to show that the bulk of the water comes from but little depth from within the chalk." This topographical information is decidedly new, and the inference as to the water is debatable. The writer accepts Mr. Middleton's view that the water-level has not been affected by wells.

Quite lately Mr. H. W. Monckton has published a paper "On a Section in the Westleton Beds at Ayot Brickfield," * in which he describes a stratified sandy gravel mainly composed of flint-pebbles, but with many subangular flints and quartz-pebbles, and with some pebbles of quartzite. The chief interest of the section is the way in which the Boulder Clay cuts through the gravel, until, on the south, it rests on the London Clay. The Westleton Beds, be it remarked, are of Pre-Glacial age. Whether this particular gravel should be thus classed I am not prepared to say, not having been to Ayot for many years. The section was seen during an excursion of our Society and of the Geologists' Association last year.

There has lately appeared a Drift Edition of Sheet 46, S.E. of the Geological Survey Map, the greater part of which is concerned with our county, from the neighbourhood of Markyate Street on the west, to Bennington and part of Hertford on the east, and from Lilley, by Stevenage, to Yardley on the north, and to Hatfield on the south. The colours added to this edition cover the greater part of the map, and represent the following six divisions:—River and Valley Gravel, Loam, Clay with Flints, and three members of the Glacial Drift, namely, Boulder Clay, Loam, and Gravel and Sand. The divisions of the Chalk (Upper, Middle, and Lower) are also shown, with the outcrops of the Chalk Rock and of the Melbourn Rock, whilst the Chalk Marl is separated from the rest of the Lower Chalk by the outcrop of the Totternhoe Stone. This is a valuable addition to the details of Hertfordshire geology.

It seems to me that one may fairly conclude with a few remarks on the advisability of the process followed in this address being continued and extended. Would it not be well if every year we

* 'Geol. Mag.,' dec. iv, vol. vi, pp. 59, 60 (1899). See also 'Proc. Geol. Assoc.,' vol. xv, p. 308.

had such an account of Hertfordshire science under each great division, botanists and zoologists giving us their results separately, as I have now done for the geologists?

If the work were divided in this way it would be fairly easy, and our 'Transactions' would then contain notes of all the scientific work relating to the county, a most useful thing.

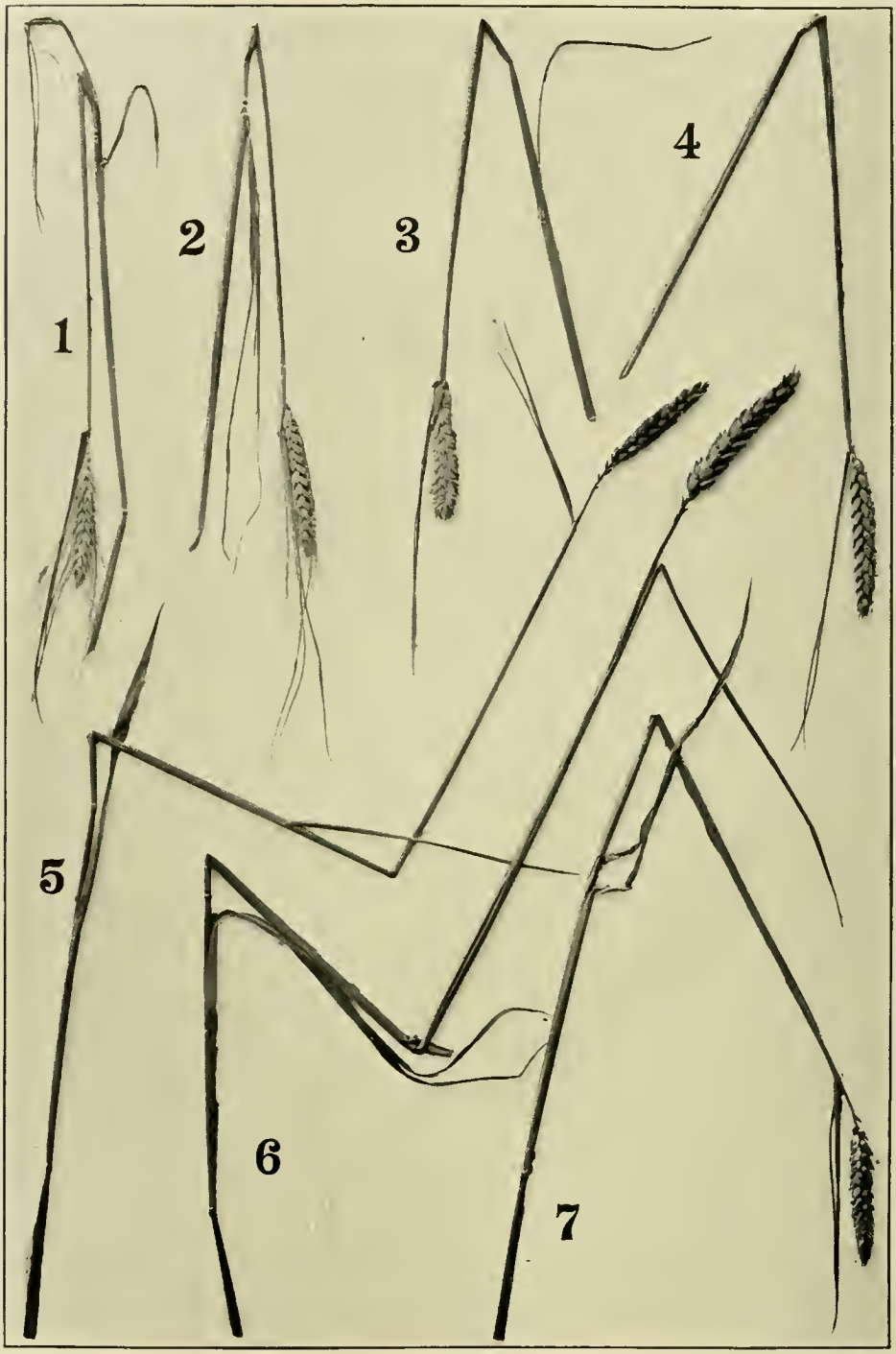
Were this done I venture to say that other kindred societies would follow suit, and we should be on our way to a topographic arrangement of natural science, by counties or by other convenient districts. As an unit of government the county is increasing in importance, and by such means as those alluded to the work of county societies might be brought into line with other public work and made more readily available for public use.

XIV.

METEOROLOGICAL NOTE.

Read at Watford, 28th March, 1899.

Lunar Halos were observed in Hertfordshire on the night of the 28th of December, 1898. The following is a description of them as seen at Much Hadham, contributed by Mrs. Gayton to the 'Hertfordshire Mercury' of 31st Dec. "On Wednesday night, at 20 minutes to 10, there were four perfect arcs of grey colourless light, two on each side of the brilliant moon, and running (roughly speaking) south-south-east to north-north-west, from horizon to horizon, parallel to each other. The outer ones were less distinct, but not close to the larger ones. The sky was cloudless, but not free from haze. At 10 p.m. these arcs had nearly faded away. At 1 a.m. the ground was white with frost, and later came rain." In the 'Herts Mercury' they are described as "lunar coronas," but it was evidently the rarer phenomena of halos which were seen.—*J. Hopkinson, St. Albans.*



WHEAT-STALKS DAMAGED BY HAILSTONES.

XV.

ON SOME EFFECTS OF THE HAILSTORM OF THE 24TH OF JUNE, 1897, IN HERTFORDSHIRE AND BEDFORDSHIRE.

By James Saunders.

Read at Watford, 28th March, 1899.

PLATE II.

The more striking features of the storm of the 24th of June, 1897, have been described by numerous observers. I have not, however, seen any account of the secondary effects on the growing corn which had been damaged by the hailstones.

It will be easily understood that the force of the wind bent the stalks of the corn so that the convex side of the curve was presented to the full effect of the pelting hail. As a consequence some of the stalks were cut off sharply as though with a knife, others were so injured that the portion above the damage hung down parallel with the lower part of the stalk when it regained its normal position, and in others the damage was more partial, the portions above the injury depending at various angles with the base of the stem.

The proportion of injured stalks in certain fields varied from a few scattered instances at the edge of the affected area as at Stopsley, to fully one half the crop as at Cockernhoe and Lilley Bottom.

My first visit to the affected area was on July 3rd, nine days after the storm. The most striking feature then noticed was the numerous blanched ears of wheat, dead and withered, and suspended by the damaged but unbroken fibres at the point of injury. (See Plate II, figs. 1–4.)

My next visit was a fortnight later, on July 17th. It was then noticed that where the injury to the stalks was so great that the ears were rendered abortive, *the next lower internode perished also*, and a disarticulation could easily be effected at the next node below, which is, of course, at the zone of intercalary growth. Taking the injured part between the fingers and giving it a slight pull, not only did the portion above the injury come away easily, but the whole of the remainder of the internode.

In the case of oats but few stalks were broken. The hail was so violent that the corn was stricken out of the panicles, the lower flowerless glumes being left. It was noticed here that in every case where the corn had escaped injury the lower glumes retained their greenness, but that where the oats had been cast out by the hail these glumes had withered. The inference to be drawn from both cases is that, the injury being irreparable, the supply of nourishment was stopped because it could not be conveyed to the fruit-bearing part of the plant. In some cases, where the injury

was extensive, the entire stalk was blanched, and at the junction with the root the connective tissues had decayed. Hence there was no waste of food-material in supporting parts of the plant which could not perform their normal function of fruit-bearing, and the energies of the organism were directed to the support of the uninjured portions.

On a visit made on the 24th of July it was noticed that where the damage to the stem was only partial, and the ear received a certain amount of nourishment, there was an effort made to raise the spike up into the light and air, for the purpose of ripening. This was accomplished by a curious contrivance. The joint next below the injured part had curved upwards by what is known as nutation, that is, one side had grown more rapidly than the other, and had thus raised the immature ear at an angle of thirty to forty degrees. The joint had also become thickened on the lower side of the bend so as to sustain the extra tension resulting from the position of the ripening ear. Whether it was heliotropism or apo-geotropism, or a combination of both forces, which effected this change in the direction of the stem, I am not sufficiently informed to say. It is patent that an injured stem could not convey so much nourishment as an uninjured one, hence the ears in these cases had only a percentage of ripe grains at the time of harvest. It was certainly a curious sight when passing through a field of wheat to see perhaps half of the crop with the stems bent at an acute angle. (See Plate II, figs. 5 and 6.)

My last visit to the hail-struck cornfields was paid on July 31st. The only salient feature then observed was that in a field which was being cut, every plant which had received injury had thrown up one diminutive ear or more direct from the root, so that the crop presented a curious mottled appearance, the bulk being ready for the sickle, and, interspersed with the ripened portion, were these green ears. It was apparent that Nature had sought to make up the deficiency by starting the second crop. Were these shoots produced from dormant buds?

Although these notes are brief and imperfect, it is hoped that they are of sufficient interest to warrant their being brought to the attention of the Society.

EXPLANATION OF PLATE II,

Illustrating damage to corn-crops by hailstones, 24th June, 1897.

Figs. 1–4. Wheat-stalks collected near Wigmore Hall, July 3. The stalks are bent at varying angles at the point of injury; the ears are abortive.

Figs. 5–7. Wheat-stalks collected near Mangrove, July 24. In figs. 5 and 6 the nodes are thickened above the damage and the stalks have bent upwards to elevate the partially abortive ears for ripening. In fig. 7 the stalk has not recovered itself and the ear is abortive.

All the figures are one-fifth natural size.

XVI.

REPORT ON THE RAINFALL IN HERTFORDSHIRE IN THE YEAR 1898.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

Read at Watford, 28th March, 1899.

The first annual report on the rainfall in Hertfordshire, that for the year 1876, contained the results of observation taken at 23 stations. There has been a gradual increase in the number of observers, and the addition of four in 1898 to the number for the previous year more than doubles that for 1876, bringing the number up to 48. Three stations disappear from our list—Cowicks, Sawbridgeworth, the observer having left the neighbourhood; Fairhill, Berkhamsted; and the Old Nurseries, Cheshunt. The additional stations are Melbourne Street, Royston; Baldock, which adds a river district, the Upper Ivel; Cowroast, Tring, a former station replaced; Rose Cottage, Berkhamsted; Little Callipers, Chipperfield; Desmond Cottage, Bennington; and Gilston Park, which replaces Sawbridgeworth as the only station in the Stort river district, and, although near Harlow in Essex, is on the Hertfordshire side of the county boundary.

The number of daily records received is 36, which is one more than in the previous year.

Particulars of the 48 rainfall stations, and the monthly and total rainfall and number of days of rain in the year 1898, are given in Tables I and II, pp. 123–125.

A supplementary table (Table III, p. 126) gives six other records of the total rainfall in the year. Two are the records of additional gauges at Rothamsted, one is that of an additional gauge at Odsey, one is that of a third gauge at Royston, and two are imperfect records omitted from Table II.

The mean rainfall in the county in the year 1898 was 19·39 inches. This is 7·35 inches below the average for the decade 1880–89, and 7·04 inches below that for the half-century 1840–89. The year was, therefore, one of very small rainfall, in fact smaller than in any other year in this period. The mean number of wet days in the year was 152, being 16 less than the average for the twenty years 1870–89. A smaller number has been recorded.

The defect in the year's rainfall was almost entirely in the first nine months, in only one of which—May—was the fall above the average. October was, as usual, the wettest month in the year, but the fall was nearly a tenth of an inch below the very high average for the month in the half-century 1840–89. In May and December the fall was more than half an inch in excess of the average. In the first nine months the fall was 7·36 inches below the average for the same period in the half-century, and in the last three months it was 0·32 inch above this average.

Droughts in 1898.—Droughts—"absolute" of more than 14 days'

duration, or "partial" of more than 28 days—occurred in the months of July, August, and September. The first absolute drought was in July, at ten stations, and lasted for 19 days, July 2 to 20, at two stations; for 18 days, June 30 to July 17, at one station; for 17 days, July 2 to 18, at two stations; and for 16 days, July 2 to 17, at five stations; its average duration being 17 days. The second absolute drought was in September, at 31 stations, and was therefore much more general over the county than the first. It lasted for 23 days, August 30 to September 21, at one station (Broxbourne); for 19 days, August 30 to Sept. 17, at nineteen stations; for 18 days, August 31 to Sept. 17, at ten stations; and for 17 days, August 31 to Sept. 16, at one station; its average duration being 19 days.

There was a partial drought at all stations for 32 days, August 17 to September 17, with an average of 0·008 inch of rain per diem. At thirty stations it lasted for 44 days, with 0·007 inch per diem. Partly overlapping this there was also at thirteen stations a partial drought for 45 days, August 30 to October 13, with an average of 0·008 inch of rain per diem. At Odsey the partial drought was prolonged over both these periods, only 0·58 inch of rain having fallen in the 59 days, August 16 to October 13.

Distribution of the Rainfall throughout the Year.—Of the total rainfall of 19·39 inches, 3·04 inches fell during the first quarter of the year, 5·92 inches during the second, 2·63 inches during the third, and 7·80 inches during the fourth. During the winter of 1897–98 (Dec. to Feb.) 4·64 inches fell, during the spring of 1898 (March to May) 5·49 inches, during the summer (June to August) 3·89 inches, and during the autumn (Sept. to Nov.) 5·57 inches. May, October, and December were wet months, November was rather wet, but below the average, January and September were very dry, February and July were dry, and March, April, June, and August were rather dry. The aggregate rainfall in the four wet months was three and a half times as much as in the four dry ones.

The difference in each month from the mean for the half-century was as follows:—Jan. —1·58, Feb. —0·66, March —0·35, April —0·28, May +0·60, June —0·41, July —1·56, August —1·12, Sept. —2·00, Oct. —0·09, Nov. —0·27, Dec. +0·68.

The absolute maximum falls in any one day in each month, and the stations recording them, were—Jan. 5, Kensworth, 0·48 in.; Feb. 5, Moor Park, Rickmansworth, 0·28 in.; March 24, Fanhams Hall, Ware, 0·84 in.; April 27, London Road, Royston, 0·49 in.; May 19, Desmond Cottage, Bennington, 0·92 in.; June 9, Much Hadham, 0·67 in.; July 28, Rothamsted, Harpenden, 0·77 in.; August 7, Southgate, 0·60 in.: Sept. 29, Pendley Manor, Tring, 0·66 in.; Oct. 29, Red House, Ware, 1·17 in.; Nov. 23, Bulbourne, Tring, 0·97 in.; Dec. 6, London Road, Royston, 1·07 in.

The day in each month on which a heavy fall of rain was most general over the county was—Jan. 5, Feb. 5 (and 18), March 26, April 27, May 19, June 24, July 28, August 7, Sept. 29, Oct. 29, Nov. 23 (and 25), Dec. 6.

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS, 1898.

District.	STATION.	OBSERVER.	Diameter of Gauge.	Height of Gauge above		
				Ground.		Sea-level.
			ins.	ft.	ins.	ft.†
1.	*Royston—London Road	Hale Wortham	8	0	6	269
,,	,, Melbourne Street.	Joseph E. J. Phillips	8	0	11	201
..	*Odsey	H. George Fordham	5	1	0	256
2.	*Baldock	F. W. Langston Day	5	1	4	214
3.	Hitchin—The Firs	William Lucas	5	2	1	238
,,	* ,, Bancroft	Francis Ransom	5	0	9	212
,,	,, The Maples	William Hill.....	8	1	1	220
,,	* ,, High Down	Joseph Pollard	5	1	3	422
4.	Tring—Pendley Manor.....	J. G. Williams.....	5	2	0	500 ?
,,	,, Bulbourne.....	Gordon Thomas	5	2	3	401
6.	*Cowroast	Gordon Thomas	5	3	8	394
,,	,, Offside Cottage ...	Richard Leah	5	1	6	420 ?
,,	*Northchurch—The Limes...	F. L. Sutton.....	5	1	0	400 ?
,,	*Berkhamsted—Rosebank ..	Edward Mawley	8	1	0	401
..	* ,, Rose Cottage	W. E. Milner	5	1	0	334
7.	*Great Gaddesden Vicarage...	Rev. W. T. T. Drake	8	1	0	427
,,	*H. Hempstead—Apsley Mills	J. Dickinson & Co. ...	24	0	9	260
,,	* ,, Nash Mills..	,,	12	3	9	237
,,	Kg.'s Langley—Laurel Bank	Isaac Butler	5	1	0	283
,,	Chipperfield—Little Callipers	Arthur W. Rivington	5	0	7	407
8.	*Kensworth—The Grove	Miss S. Grace Jones	5	1	0	630 B
,,	Harpenden—Rothamsted ...	Lawes and Gilbert ...	5	0	9	420 T
,,	*St. Albans—Gorhambury ...	W. Newberry	5	1	0	423 T
,,	* ,, The Grange ...	John Hopkinson	5	1	0	380
,,	* ,, Bone Hill	H. J. T. Broadwood	5	1	0	336
9.	* Elstree—Aldenham House	Edwin Beckett	10 sqr.	4	9	305
10.	* Watford—St. Alban's Road	H. Ruddle	5	1	0	250 ?
,,	* ,, London Orphan Asylum	Dr. O. C. Cockrem	5	1	0	231
,,	* ,, Frogmore	Arthur P. Blathwayt	5	1	0	182
,,	,, Colne Val. Water W'ks.	William Verini.....	5	1	0	220
,,	*Rickmansworth—Moor Park	Lord Ebury	5	2	0	340
12.	*Welwyn—Bridge House ..	B. Wilfred Thomas ...	5	0	6	228 ?
,,	*Datchworth Rectory	Rev. Andrew Amos ..	5	1	0	386 T
,,	Hertford—Marden Hill.....	Richard Hoare	5	1	0	257 T
,,	*Stevenage—Weston Park ...	M. R. Pryor	5	0	8	470 T
,,	*Bennington—Desmond Cot-					
13.	tage	Miss M. C. Nihill.....	5	1	0	408
,,	* ,, Bennington House ..	Rev. Dr. Parker	5	1	0	408
14.	*Therfield Rectory	Rev. J. G. Hale	5	4	0	510
,,	*Throcking Rectory.....	Rev. C. W. Harvey...	5	1	0	484 T
,,	*Buntingford—Hamels Park	E. Wallis	5	1	0	400 T
15.	*Much Hadham	T. Woodham Mott ...	5	1	0	222 B
16.	Harlow—Gilston Park	William Cowper	8	0	6	175
17.	*Hertford—Bayfordbury.....	W. Clinton Baker ..	8	1	2	250
,,	*Ware—Red House	Joseph Francis	5	0	9	112 T
,,	* ,, Fanhams Hall	Miss V. M. Croft.....	8	1	0	253 T
18.	*Broxbourne—Stafford House	G. J. Newbery	5	1	0	118 T
,,	*New Barnet—Gas Works ...	T. H. Martin	8	0	9	212
,,	*Southgate—The Lawns.....	George A. Church ..	5	0	6	240 T

* Daily fall received. † For explanation of these symbols see Vol. VII, p. 53.

TABLE II.—RAINFALL OF HERTFORDSHIRE IN 1898.

River Districts.			Stations.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Days.
				in.	in.	in.	ins.	ins.	ins.	in.	in.	in.	ins.	ins.	ins.	ins.	
OUSE	CAM	1. Rhee	Royston—London Road	·76	·96	1·54	2·03	2·81	2·13	1·22	1·38	·24	2·73	2·40	3·05	21·25	149
			,, Melbourne Street	·80	·98	1·27	2·06	2·80	2·16	1·35	1·26	·23	2·67	2·21	2·78	20·57	144
			Odsey	·73	·77	1·34	1·44	3·09	2·12	1·22	1·32	·28	2·82	2·22	2·69	20·04	156
	IVEL	2. Upper Ivel	Baldock	·64	·90	1·60	1·54	3·19	2·33	1·39	1·49	·31	2·67	2·07	2·61	20·74	146
		3. Hiz	Hitchin—The Firs	·54	1·11	1·27	1·30	2·82	1·92	·93	1·39	·32	2·46	2·31	2·81	19·18	163
			,, Bancroft	·69	1·18	1·34	1·40	2·79	2·11	1·00	1·47	·29	2·39	2·26	2·67	19·59	167
			,, The Maples	·66	1·06	1·27	1·36	2·85	2·29	·94	1·40	·32	2·35	2·27	2·81	19·58	155
			,, High Down	·74	·95	1·13	1·47	3·29	2·13	1·06	1·78	·32	2·37	2·25	2·63	20·12	175
	THAME	4. Up. Thame	Tring—Pendley Manor	·76	1·10	1·39	1·85	2·44	1·22	·84	1·11	·71	2·87	2·85	2·68	19·83	161
			,, Bulbourne	·75	1·13	1·20	1·69	2·13	1·40	1·17	1·01	·66	2·67	2·83	2·65	19·29	159
	COLNE	6. Bulbourne	Cowroast	·79	1·12	1·17	1·57	2·39	1·17	·75	1·26	·68	2·60	2·73	2·81	19·04	129
			,, Offside Cottage	·76	1·05	1·66	1·51	2·45	1·18	·78	1·30	·65	2·60	2·76	2·71	19·41	156
			Northchurch—The Limes	·79	1·04	1·08	1·53	2·23	1·28	·71	1·09	·67	2·61	2·68	2·58	18·29	136
			Berkhamsted—Rosebank	·81	1·20	1·30	1·46	2·28	1·06	·60	1·25	·71	2·78	2·71	2·68	19·13	158
			,, Rose Cottage	·81	1·25	1·33	1·55	2·36	1·19	·65	1·34	·71	2·79	2·74	2·67	19·64	158
		7. Gade	Great Gaddesden Vicarage	·93	1·02	1·30	1·66	2·70	1·18	·94	1·19	·66	2·42	2·83	2·67	19·50	148
			Hemel Hempstead—Apsley Mills	·76	1·30	1·20	1·50	2·43	1·36	·59	·89	·63	2·86	2·75	2·86	19·13	151
			,, Nash Mills	·58	·98	1·01	1·19	1·89	1·56	·46	·98	·67	2·60	2·63	2·85	17·40	129
			King's Langley—Laurel Bank	·74	1·21	1·16	1·40	2·36	1·66	·48	1·00	·55	2·96	2·63	2·71	18·86	
			Chipperfield—Little Callipers	·75	1·10	1·13	1·47	2·32	1·60	·50	1·01	·49	2·61	2·56	2·48	18·01	
		8. Ver	Kensworth—The Grove	·99	1·19	1·07	1·67	2·61	1·53	1·37	1·22	·53	3·02	2·46	2·94	20·60	146
			Harpenden—Rothamsted	·76	1·01	·99	1·36	2·73	1·52	1·38	1·08	·52	2·75	2·32	2·82	19·24	157
			St. Albans—Gorhambury	·77	1·13	1·22	1·51	2·45	1·73	·90	1·17	·48	2·68	2·42	2·60	19·06	155
			,, The Grange	·75	1·10	1·36	1·48	2·57	1·76	1·00	1·19	·42	2·83	2·28	2·38	19·12	165
			,, Bone Hill	·82	1·16	·98	1·38	2·41	1·67	·75	1·10	·40	2·71	2·17	2·35	17·86	164
		9. Up. Colne	Elstree—Aldenham House	·72	1·22	1·04	1·24	2·82	1·50	·64	1·42	·54	3·32	2·54	2·40	19·40	143
		10. Lo. Colne	Watford—St. Albans Road	·67	1·04	·95	1·27	2·80	1·33	·65	1·28	·64	2·66	2·32	2·59	18·20	
			,, London Orphan Asylum	·78	1·14	·93	1·21	2·56	1·32	·44	1·49	·40	2·40	2·20	2·50	17·36	142
			,, Frogmore	·70	·98	·77	1·13	2·56	1·54	·48	1·25	·41	2·45	1·99	2·39	16·65	147
			,, Colne Valley Water Works	·79	1·12	·97	1·27	2·56	1·50	·58	1·53	·50	2·59	2·25	2·52	18·18	166
			Rickmansworth—Moor Park	·95	1·55	1·29	1·43	2·91	1·15	·49	1·39	·61	3·28	2·79	2·93	20·77	170
THAMES	LEA	12. Mimram	Welwyn—Bridge House	·60	·87	1·39	1·19	3·05	1·78	1·13	1·12	·34	2·84	2·05	2·81	19·17	146
			Datchworth Rectory	·51	·88	1·00	1·27	3·02	1·73	·94	1·14	·36	3·13	2·05	2·91	18·94	136
			Tewin—Marden Hill	·74	·77	1·28	1·24	2·80	1·55	1·01	1·17	·29	2·58	1·80	2·79	18·02	129
			Stevenage—Weston Park	·78	1·09	1·62	1·49	3·30	2·16	1·21	1·02	·38	2·95	2·18	3·08	21·26	161
		13. Beane	Bennington—Desmond Cottage	·61	·98	1·40	1·76	3·61	2·39	1·18	·92	·17	3·09	1·87	2·57	20·55	150
			,, Bennington House	·58	·91	1·37	1·72	3·18	2·21	1·13	1·16	·29	3·16	1·97	2·59	20·27	167
			Therfield Rectory	·82	·90	1·41	1·68	3·19	2·53	1·43	1·32	·27	3·06	2·30	2·76	21·67	162
		14. Rib	Throcking Rectory	·80	·91	1·23	1·41	3·03	2·36	1·12	1·10	·28	3·32	2·19	2·99	20·71	170
			Buntingford—Hamels Park	·77	·92	1·71	1·72	3·18	2·02	1·02	1·41	·29	3·20	2·15	2·69	21·08	134
		15. Ash	Much Hadham	·66	1·08	1·61	1·42	3·39	2·55	1·61	1·45	·26	2·98	2·01	2·60	21·62	148
		16. Stort	Harlow—Gilston Park	·64	·86	1·36	1·57	3·30	1·72	1·54	1·30	·32	3·30	1·78	2·58	20·27	
			Hertford—Bayfordbury	·59	·89	1·21	1·70	2·36	1·32	1·30	1·34	·33	2·97	1·90	2·43	18·34	157
		17. Upper Lea	Ware—Red House	·54	·83	1·34	1·95	2·83	1·34	·85	1·48	·36	3·32	1·81	2·10	18·75	133
			,, Fanhams Hall	·59	·96	1·61	2·00	3·01	1·52	·87	1·61	·27	3·20	1·91	2·53	20·08	146
			Broxbourne—Stafford House	·62	·92	1·18	1·38	2·22	1·58	1·13	1·65	·26	3·45	1·71	2·52	18·62	157
		18. Lower Lea	New Barnet—Gas Works	·80	1·22	1·16	1·28	2·60	1·28	·56	1·24	·32	3·42	1·85	2·46	18·09	133
			Southgate—The Lawns	·98	1·21	1·17	1·39	2·55	1·42	·60	1·11	·40	3·36	1·73	2·20	18·14	163
Mean for the County				·73	1·05	1·27	1·50	2·73	1·69	·94	1·26	·43	2·85	2·29	2·66	19·39	152

TABLE III.—SUPPLEMENTARY TO TABLES I AND II.

District.	Station.	Observer.	Gauge.		Rainfall.	Days.
			Diameter.	Height above Sea.		
			ins.	feet.	ins.	
1.	Royston—Workhouse	J. W. Weston	5	217	21·17	138
,,	Odsey (2nd gauge).....	H. G. Fordham..	5	256 ⩓	19·92	157
6.	Berkhamsted—Fairhill ..	W. B. Hopkins.....	5	548 ⊤	17·06	152
8.	Harpenden—Rothamsted	Sir J. Lawes and	8	420 ⊤	18·72	145
,,	,, ,,	Sir H. Gilbert.....	72 × 87	420 ⊤	20·49	159
18.	Cheshunt Nurseries	Paul & Son	5	240 ⊤	14·88	106

The average number of wet days in each month was as follows:—Jan., 10; Feb., 15; March, 12; April, 11; May, 22; June, 14; July, 8; August, 12; Sept., 4; Oct., 15; Nov., 15; Dec., 14.

The deviation from the mean for the 20 years 1870–89 was—Jan., −5; Feb., +1; March, −1; April, −2; May, +9; June, +1; July, −6; Aug., −1; Sept., −9; Oct., =; Nov., −1; Dec., −2.

Distribution of Rainfall throughout the County.—The following table (Table IV) gives the mean fall in each month and for the year in each of the five river districts represented, and in the two main hydrographical divisions of the county, the catchment basins of the Great Ouse and of the Thames, and also the difference in the year from the mean for the decade 1880–89.

TABLE IV.—RAINFALL IN THE RIVER-DISTRICTS.

MONTHS.	CAM.	IVEL.	THAME.	COLNE.	LEA.	OUSE.	THAMES.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	·76	·65	·76	·78	·68	·69	·74
Feb.	·90	1·04	1·11	1·14	·95	·99	1·06
March	1·39	1·32	1·30	1·16	1·35	1·35	1·25
April	1·84	1·41	1·77	1·42	1·54	1·58	1·49
May	2·90	2·99	2·29	2·49	2·98	2·95	2·69
June	2·14	2·16	1·31	1·45	1·85	2·15	1·61
July	1·26	1·06	1·00	·72	1·10	1·14	·89
August	1·32	1·51	1·06	1·21	1·27	1·44	1·23
Sept.	·25	·31	·69	·57	·31	·29	·46
October	2·74	2·45	2·77	2·74	3·14	2·56	2·91
Nov.	2·28	2·23	2·84	2·51	1·95	2·25	2·29
Dec.	2·84	2·71	2·66	2·64	2·62	2·76	2·63
Year	20·62	19·84	19·56	18·83	19·74	20·15	19·25
Diff. from 1880–89	−2·88	−5·43		−10·14	−5·81	−4·33	−8·10

The mean fall in each of the minor river-basins or sub-districts represented was as follows:—(*Cam*) Rhee, 20·62 ins.; (*Ivel*) Upper

Ivel, 20·74 ins.; Hiz, 19·62 ins.; (*Thame*) Upper Thame, 19·56 ins.; (*Colne*) Bulbourne, 19·10 ins.; Gade, 18·58 ins.; Ver, 19·18 ins.; Upper Colne, 19·40 ins.; Lower Colne, 18·23 ins.; (*Lea*) Mimram, 18·71 ins.; Beane, 20·69 ins.; Rib, 21·15 ins.; Ash, 21·62 ins.; Stort, 20·27 ins.; Upper Lea, 19·06 ins.; Lower Lea, 18·24 ins.

The total yearly fall ranged from 16·65 inches at Frogmore, Watford, to 21·67 inches at Therfield Rectory; and the total monthly fall from 0·17 inch at Desmond Cottage, Bennington, in September, to 3·61 inches at the same station in May. The greatest fall in any one day was 1·17 inch at the Red House, Ware, on the 29th of October.

Distribution of the Rainfall in each Month.—The nomenclature used in the following account of the chief falls of rain is the same as in my previous reports, falls of at least $\frac{1}{2}$ inch being styled *considerable*, $\frac{3}{4}$ inch *very considerable*, and 1 inch *great*. There was no *very great* ($1\frac{1}{4}$ inch) fall of rain during the year. This analysis only applies to the thirty-six stations for which I have returns of the daily rainfall. The wettest days which are given in each month are those at forty-four stations.

January.—Very dry, especially after the first week; there were also very few wet days. No snow fell. The only *considerable* fall of rain was at St. Albans Road, Watford, on the 5th. The 4th was the wettest day at 2 stations, the 5th at 42, the 6th at 2, and the 4th and 5th were the wettest at one station.

February.—A dry month, but with about the average number of wet days. Snow fell on about eight days, and hail on three. There was no *considerable* fall, either as rain or snow. The 3rd was the wettest day at 5 stations, the 5th at 17, the 27th at 18, the 12th at one station, the 18th at one, the 26th at one, the 3rd and 5th were the wettest at 2 stations, the 5th and 27th at one station, and the 26th and 28th at one.

March.—Rather dry, with about the average number of wet days. Snow fell on about eight days at the beginning and towards the end of the month, and hail fell on two days. On the 24th there was a *very considerable* fall of rain at Fanhams Hall, Ware, and on the 26th there was a *considerable* fall at Offside Cottage, Cowroast. The 3rd was the wettest day at one station (Southgate), the 24th at 5 stations, and the 26th at 42.

April.—Rather dry, with about the average number of wet days. Hail fell on two days. There was no *considerable* fall of rain. The 11th was the wettest day at 6 stations, the 26th at 3, the 27th at 32, the 9th at one station, the 14th at one, the 28th at one, the 11th and 27th were the wettest at one, and the 11th, 14th, and 26th at one.

May.—A wet month with many wet days, and hail on two. On the 19th the fall was *considerable* at 10 stations and *very considerable* at 3 (in the Lea basin), and on the 20th it was *considerable* at 4. The 19th was the wettest day at 33 stations, the 20th at 11, the 30th at 2, and the 1st and 20th were the wettest at one station.

JUNE.—Rather dry, with about the average number of wet days. On the 9th the fall was *considerable* at Royston and Much Hadham, on the 26th at Therfield, and on the 27th at Bancroft, Hitchin. The 9th was the wettest day at 8 stations, the 24th at 18, the 25th at 2, the 26th at 4, the 27th at 12, the 2nd at one station, the 6th at one, and the 23rd at one.

JULY.—A dry month, with rain on very few days. Between the 1st and the 18th (16 days) there was no rain at ten stations, and only a very small fall on one day (9th) at the rest. On the 28th there was a *considerable* fall at 9 stations (chiefly in the Lea basin). The 1st was the wettest day at 19 stations, the 28th at 27, and the 1st and 28th were the wettest at one station.

AUGUST.—Rather dry, with about the average number of wet days. There were several thunderstorms during the last half of the month, but with a very small amount of rain. On the 7th there was a *considerable* fall at 3 stations, and on the 15th at 3. The 7th was the wettest day at 34 stations, and the 15th at 13.

SEPTEMBER.—Exceedingly dry, with rain on a very small number of days, at most stations only on 18th, 19th, 28th, and 29th. The 29th was the wettest day at all stations, and at 8 (all in the Colne basin) the fall was *considerable* on this day.

OCTOBER.—The wettest month in the year, with rain on the average number of days. On the 9th the fall was *considerable* at one station (Nash Mills), on the 16th at 6 stations, on the 17th at 2, on the 18th at 2, on the 19th at one station, and on the 28th at one. On the 29th it was *considerable* at 8 stations, *very considerable* at 7, and *great* at Fanhams Hall, Ware (1·01 in.), New Barnet (1·02 in.), Southgate (1·05 in.), Throcking (1·08 in.), Hamels Park (1·08 in.), Therfield (1·09 in.), Odsey (1·12 in.), Broxbourne (1·15 in.), and the Red House, Ware (1·17 in.). The 17th was the wettest day at 5 stations, the 28th at 3, the 29th at 37, the 9th at one station, and the 19th at one.

NOVEMBER.—Rather wet, with rain on about the average number of days. Much the wettest period was from the 20th to the end of the month. Snow fell on three days. On the 2nd the rainfall was *considerable* at 2 stations, on the 23rd it was *considerable* at 4 and *very considerable* at one station, and on the 25th it was *considerable* at 8 stations and *very considerable* at 3. The 2nd was the wettest day at 3 stations, the 23rd at 20, the 24th at 5, the 25th at 18, and the 21st and 24th were the wettest at one station.

DECEMBER.—A wet month, but with rain on rather less than the average number of days, the excess being due to a few heavy falls. On the 6th the rainfall was *considerable* at 10 stations, *very considerable* at 24, and *great* at Fanhams Hall, Ware (1·03 in.), and Royston (1·07 in.); on the 18th it was *considerable* at 13 stations, *very considerable* at Weston Park, and *great* at Throcking (1·00 in.); and on the 27th it was *considerable* at 6 stations, and *very considerable* at Moor Park. The 6th was the wettest day at 44 stations, the 18th at 2, and the 27th at one station.

XVII.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1898.

By Edward Mawley, Sec. R. Met. Soc., F.R.H.S.

Read at Watford, 28th March, 1899.

In no previous year have the Society's observing stations been quite as evenly distributed over the county as in that to which the present report has reference. In fact, the only part of Hertfordshire which is now altogether unrepresented is the neighbourhood of Buntingford. Since the last report was issued the Society has lost an observer at Radlett and another at St. Albans (Addiscombe Lodge), but on the other hand two new stations have been started, one at Chesham (Bucks) and the other at Sawbridgeworth, a part of the county where an observer has been for some years greatly needed. The Hatfield observations, which were missing from the last report, have, I am pleased to say, been resumed.

The following table contains the list of observers, the districts they represent, and the approximate height of the stations above sea-level :—

Station.	Height above Sea-level.	Observer.
Watford (The Platts)	240 feet.	Mrs. G. E. Bishop.
Chesham (Cannon Mill Cottage)	300 ,,	Miss G. Keating.
Broxbourne	120 ,,	Rev. H. P. Waller.
St. Albans (The Grange)	380 ,,	Mrs. J. Hopkinson.
St. Albans (Worley Road)	300 ,,	Henry Lewis.
Berkhamsted (Rosebank)	400 ,,	Mrs. E. Mawley.
Hatfield (Symonds Hyde)	300 ,,	T. Brown.
Hertford	140 ,,	W. Graveson.
Sawbridgeworth	240 ,,	H. S. Rivers.
Harpenden	370 ,,	J. J. Willis.
Hitchin	230 ,,	A. W. Dawson, M.A.
Ashwell (Odsey)	260 ,,	H. G. Fordham.

The Winter of 1897–98.

This was a remarkably warm and dry winter. The only frosty periods occurred at Christmas and at the end of February, and they lasted on each occasion but a few days. So mild was the season throughout that at no time did the thermometer exposed on my lawn at Berkhamsted show more than 15 degrees of frost—its average extreme minimum for the preceding eleven winters being 25 degrees of frost. The December rainfall was in excess of the average, but during January and February the weather continued unusually dry.

The autumn-sown corn crops made steady progress during the season, but it was only here and there that they were so forward

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1898, WITH THE MEAN DATE FOR 1876–1897.

SPECIES.	WATFORD.	CHESHAM.	ST. ALBANS.	BERKHAMSTED	HARPENDEN.	HATFIELD.	HERTFORD.	BROXBOURNE.	SAWBRIDGEWORTH.	HITCHIN.	ASHWELL (Odsey).	MEAN, 1876–97.
Hazel (*Corylus avellana*)	Jan. 18	.....	Jan. 23	Feb. 17	Jan. 20	.....	Jan. 30	Jan. 23	.....	Jan. 22	Jan. 20	Jan. 29
Coltsfoot (*Tussilago farfara*)	.....	.....	Feb. 28	Jan. 31	Mar. 4	Mar. 18	Feb. 9	Mar. 2	.....	Feb. 6	Feb. 27	Feb. 26
Wood-Anemone (*Anemone nemorosa*)	Mar. 31	.....	.....	Apl. 5	Mar. 20	Apl. 15	Mar. 13	Mar. 20	.....	.....	.....	Mar. 20
Blackthorn (*Prunus spinosa*)	Mar. 29	.....	.....	Apl. 9	Apl. 6	.....	Mar. 17	Apl. 4	.....	.....	Mar. 20	Apl. 2
Garlic Hedge-Mustard (*Alliaria officinalis*)	Apl. 26	.....	Apl. 16	Apl. 19	Apl. 28	.....	Mar. 27	.....	.....	Apl. 15	.....	Apl. 20
Horse-Chestnut (*Æsculus hippocastanum*)	May 15	.....	May 11	May 16	May 13	May 8	May 10	.....	May 14	May 5	.....	May 9
Hawthorn (*Crataegus oxyacantha*)	May 7	May 23	May 14	May 25	May 13	May 6	May 2	.....	May 23	Apl. 22	May 6	May 12
White Ox-Eye (*Leucanthemum vulgare*)	.....	June 1	May 31	May 26	May 25	.....	May 22	.....	.....	May 15	.....	May 20
Dog-Rose (*Rosa canina*)	.....	.....	June 11	June 7	June 12	June 12	June 9	.....	.....	May 25	June 5	June 5
Black Knapweed (*Centaurea nigra*)	.....	.....	June 27	July 6	June 29	.....	July 3	.....	.....	July 8	.....	June 21
Harebell (*Campanula rotundifolia*)	July 12	.....	July 17	July 17	July 15	.....	July 6	.....	.....	July 6	.....	July 5
Greater Bindweed (*Convolvulus sepium*)	July 25	July 22	Aug. 2	July 15	July 17	.....	July 24	.....	.....	July 16	.....	July 8
Ivy (*Hedera helix*)	Oct. 2	.....	.....	Oct. 4	.....	.....	Sept. 18	Sept. 10	.....	.....	Sept. 25	Sept. 27

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1898, WITH THE MEAN DATE FOR 1876–1897.

SPECIES.	WATFORD.	CHESHAM.	ST. ALBANS.		BERKHAMSTED.	HARPENDEN.	HATFIELD.	BROXBOURNE.	SAWBRIDGEWORTH.	HITCHIN.	ASHWELL (Odsey).	MEAN, 1876-97.
			The Grange.	Worley Road.								
BIRDS.												
Song-Thrush (*Turdus musicus*)	Jan. 10	.....	.....	Jan. 8	Jan. 13	Jan. 16	.....	Jan. 10	.....	Jan. 4	.....	Jan. 17
Swallow (*Hirundo rustica*)	Apl. 15	.....	Apl. 12	Apl. 15	Apl. 6	Apl. 25	Apl. 16	.....	Apl. 17	Apl. 13	.....	Apl. 12
Cuckoo (*Cuculus canorus*)	Apl. 13	.....	Apl. 16	Apl. 15	Apl. 17	Apl. 15	Apl. 14	Apl. 5	Apl. 17	Apl. 17	.....	Apl. 13
Nightingale (*Daulias luscinia*)	Apl. 16	.....	Apl. 20	Apl. 15	Apl. 20	Apl. 27	Apl. 6	.....	Apl. 23	Apl. 15	.....	Apl. 15
Spotted Flycatcher (*Muscicapa grisola*)	.....	.....	.....	.....	June 13	.....	May 18	.....	May 5	Apl. 20	May 2	.....
Swallow (last seen) (*Hirundo rustica*)	Oct. 14	.....	.....	.....	Oct. 18	.....	.....	Oct. 12	Nov. 6	.....	Nov. 11	.....
INSECTS.												
Honey-Bee (*Apis mellifica*)	.....	.....	.....	.....	Jan. 31	.....	.....	.....	.....	Jan. 6	.....	Jan. 30
Wasp (*Vespa vulgaris*)	.....	May 23	.....	.....	Apl. 4	May 1	.....	.....	.....	.....	.....	Apl. 4
Small White Butterfly (*Pieris rapæ*)	Apl. 5	.....	Apl. 16	.....	Mar. 31	Apl. 17	.....	.....	.....	.....	.....	Apl. 4
Orange-Tip Butterfly (*Anthocaris cardamines*)	.....	May 30	.....	May 6	May 22	Mar. 20	...	.....	May 14	June 6	.....	May 7
Meadow-Brown Butterfly (*Epinephile janira*)	.....	.....	.....	.....	July 10	.....	.....	.....	June 29	.....	.....	May 18

as to become what is known as "winter proud." This was no doubt owing to the dryness of the soil and the gloomy character of the weather prevailing in January. Altogether this winter proved an exceptionally favourable one for the farmer. Not only was the ground singularly warm but also singularly dry, so that tillage operations were never at a standstill. Under such circumstances it is not surprising to learn that the sowing of spring corn was commenced at an exceptionally early date and carried out under the most favourable conditions possible. At the end of the quarter the cereals are reported to have presented a sturdy and healthy appearance. The cost of maintaining cattle and sheep during this mild winter must have been very small, owing to the abundance of grass in the meadows and pastures.

In the gardens there was always a plentiful supply of green vegetables to be had, while the absence of frost enabled many plants to continue in flower throughout the whole winter. The last rose-bloom of the year in my garden at Berkhamsted fell a victim to frost on Christmas Eve, the same day as in 1896 but nearly three weeks later than the average date for the last rose in the previous twelve years. Mrs. G. E. Bishop, writing on January 15th, states that in her garden at Watford wallflowers, primroses, and Gloire-de-Dijon roses were still here and there to be seen in flower. As showing the mildness of the weather in January, Mr. A. W. Dawson instances the forward appearance of the buds on the horse-chestnut at Hitchin, as well as those of the pear and other fruit trees. As a further example I may state that at Berkhamsted the winter aconite was in flower on January 7th, which is the earliest date yet recorded for this plant during the nine years it has been under observation here.

Taking the average of all the dates sent in, the fertile flowers first appeared on the hazel four days in advance of the mean date for this shrub in the previous twenty-two years. The coltsfoot also flowered four days early.

The song-thrush was first heard, after the new year, ten days earlier than its usual time. The dates received for the honey-bee are too scanty to warrant any deductions being drawn from them.

The Spring.

This was on the whole a cold spring, but on the other hand there occurred during the course of it no frosts of exceptional severity. In fact, after the 6th of April the exposed thermometer at Berkhamsted at no time showed more than 8 degrees of frost, and in May never more than 4 degrees of frost. The weather was also as a rule very dry, the only month of the three in which the rainfall exceeded the average being May. Besides which it was an unusually sunless spring.

Although from the foregoing description the weather of the quarter may not appear altogether favourable for vegetation, the climatic conditions which prevailed during this season were in reality singularly propitious. For instance, the cereals received

the wholesome check they then needed in order to enable them to become more securely rooted; the land continued in admirable order for sowing the spring crops; while the grass, favoured by the timely arrival of rain in May, grew so rapidly that the fields were soon thickly covered with luxuriant herbage.

The fruit-trees blossomed abundantly, but, owing to the cold winds prevailing at the time, and no doubt also owing to the lack of vigour in the trees themselves due to the dry condition of the subsoil, there was only in some localities a good set of fruit.

The following notes of observation were received during the quarter. Our Watford observer mentions early potatoes growing in a sheltered position as having been blackened by frost on the night preceding the 22nd of April. Mr. Willis gives April 4th as the date of the first frog spawn. At Berkhamsted one of the most noteworthy features of the spring was the entire absence of greenfly.

Of the six spring flowering plants on the list three came into blossom rather earlier than usual, whereas the other three were behind their mean dates. The blackthorn was three days early, the garlic hedge-mustard three days early, and the hawthorn one day early. On the other hand the wood-anemone was eight days late, the horse-chestnut three days late, and the white ox-eye five days late.

The spring migrants were even more punctual than usual, the swallow arriving only three days late, while the cuckoo was only one day late and the nightingale but three days late.

So few observers gave the dates for the wasp that I am unable to say anything definite as to when it was first seen in the county generally, and the same may be said of the meadow-brown butterfly. According to the four returns sent in, the small white butterfly was five days late and the orange-tip butterfly four days late.

The Summer.

June was a changeable month as regards temperature, but on the whole cold. In July the day temperatures ruled high, while those at night were as unseasonably low. In August, however, the weather remained unusually warm throughout the month. Taking the quarter as a whole, there was a very deficient rainfall, and especially was this the case in July. In June there was comparatively little sunshine, whereas July and August were remarkably sunny months.

The crop of hay proved an unusually heavy one, and, favoured by the fine weather, was harvested in splendid condition. The cereals made excellent growth notwithstanding the scanty supply of rain, but after the middle of July the drought began to be much felt by all the other farm crops. The corn harvest, like that of hay, was a singularly abundant one, for not only was there a remarkably good yield of grain but also a heavy crop of straw. Except in those places where the corn had been beaten down by

the few heavy thunderstorms of the season, the ingathering of the cereals was in no way impeded by adverse weather-conditions.

The want of sufficient rain proved very trying, and, of course, especially was this the case on thin and porous soils, so that little growth was made after June. Strawberries, gooseberries, and other small fruits yielded good crops in most parts of the county, and were gathered under the best conditions as regards weather.

In order to give some idea as to the extent to which the soil must have become dry by the middle of the summer, I may mention that between the middle of July and the middle of August, or for a month, not a drop of rain-water came through the 2½ feet of uncropped soil in either of my percolation-gauges.

From Harpenden Mr. Willis reports that the first wheat-ear was observed out of its sheath on June 14th, the same date as in 1897, but later than in any other of the previous six years. He also states that in the early part of June there was a considerable amount of aphis, especially on roses, plums, pears, and currants. This was also the case at Berkhamsted, where the attacks of aphides on my roses were the most persistent I have ever experienced. Mr. J. Hopkinson also says that at St. Albans nearly all his currants were ruined by aphis. The same observer mentions the splendid bloom on the dog-roses in June and July in that neighbourhood, some of the hedges in the bye-roads appearing almost a mass of flowers.

The first half of the summer was cold, and the whole of it extremely dry, consequently all the plants coming into blossom during that season flowered later than usual, the dog-rose being three days late, the black knapweed twelve days late, the harebell seven days late, and the greater bindweed fourteen days late.

The Autumn.

This was the warmest autumn known in Hertfordshire, at all events during the thirteen years over which my records at Berkhamsted extend. In September especially the heat was at times very great. In each of the three months the fall of rain was deficient, but in September no rain at all fell at Berkhamsted during the first 27 days. Taking the season as a whole the sun shone at Berkhamsted for altogether 338 hours, or 3¾ hours a day, whereas the mean record for the quarter is only about 3 hours a day.

The extremely hot and dry weather in September, coming as it did after such a dry summer, brought the growth of the farm crops to a standstill. The turnips made little, if any, progress, while the pastures for weeks together presented a bare and burnt-up appearance. Between the beginning of June and the middle of October, or for 4½ months, only a quarter of an inch of rain-water came through my light-soil percolation-gauge, which is equivalent to about a gallon and a quarter of water on each square yard of surface, or 5,656 gallons to an acre—instead of an average percolation of about 120,000 gallons per acre. These facts may

perhaps convey some idea as to the dry condition of the ground when this long drought was at last brought to an end by the heavy rains which fell in the latter half of October. So hard had the ground become, that after harvest until the change of weather took place in October it was impossible to plough up the stubbles. When the rain did come the effect on the soil and also upon the grass and turnips was little short of magical. In a few days the ground was in a workable condition, and so friable, owing to the pulverizing action of the drought, that the autumn corn was soon got in in a perfect seed-bed, and with a very small amount of labour. The grass recovered rapidly, and was soon as green as ever again, and from that time there was never any lack of herbage for the cattle in the pastures. The root crops also considerably improved, but the injuries which they had received had in many cases been too great to allow of anything like a moderately-good yield. The wheat germinated readily when sown, and, favoured by the warm soil, made its appearance above ground almost as soon as if it had been planted at about the usual time.

The effect on vegetation of the rain falling on the heated soil in the gardens was almost equally surprising, but unfortunately these rains came too late to save the winter supply of vegetables, which have seldom at this season been so stunted or poor. The grass on the lawns, however, quickly responded to the genial warmth and moisture, and had to be mown before the end of the season, a by no means usual occurrence at this late period of the year. Owing to the change of weather and the absence of early autumn frosts, many plants remained in flower much later than usual. Indeed, throughout the greater part of November most gardens presented an unusually gay appearance.

According to the returns sent in to the 'Gardeners' Chronicle,' apples, taking the county as a whole, were rather over average, while plums and pears yielded indifferent crops.

Mrs. Bishop reports that on September 3rd, and again nearly a month later, her lawns at Watford were much burnt up, and that there was no grass for the cows in the meadow. It was not until the night preceding the 23rd of November that her nasturtiums and heliotropes were destroyed by frost. On the same night my dahlias at Berkhamsted were also killed by frost, which is three weeks later than the average date of their destruction in the previous thirteen years, and later than in any of those years except 1894, when they lasted till December 1st.

The only autumn-flowering plant on the list, the ivy, came into blossom two days in advance of its usual time.

XVIII.

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1898.

By Alan F. Crossman, F.L.S.

Read at Watford, 28th March, 1899.

So far as the occurrence of rare birds in the county goes, the year 1898 has been a poor one, but perhaps this is really a good thing, for, when there are many records of rare birds, it nearly always means that a great many uncommon birds have been destroyed. I only wish that everybody had the strength of mind of one of my correspondents, who, although he had a gun with him, refrained from shooting a rare bird which he saw, and contented himself with merely watching it. I have in this report only one bird to add to our county list, and that must be included under the heading of introduced species. I thought that I was to have the pleasure of including a new owl in our fauna, but I find that my correspondent at first wrongly identified the species. In fact, in the rough draft of this paper, I had included the bird, but I have since heard that out of three specimens obtained, only one which was shot just over the borders in Middlesex was of the species mentioned. The bird I refer to is the scops owl (*Scops giu*).

I am pleased to see that some of my correspondents are beginning to send me notes not only on rare birds, but also on the distribution of the more common species. This is what is required, as these annual reports are not merely for recording what is often the useless slaughter of rarities, but are more for the purpose of trying to help people to obtain a more accurate idea of the distribution of the various species of birds frequenting the county. In reference to such birds as are shot, I should like, however, to mention one or two points. One is, that when anybody who is not a collector does obtain a specimen of some species of bird, and is at a loss what to do with it, he cannot do better than present it to the County Museum at St. Albans. It is only right that local specimens should find their way into a museum which is started more especially for the purpose of showing the products of Hertfordshire. The other point is that I should be very much obliged if anyone who has in their possession stuffed specimens of birds obtained in Hertfordshire, or who comes across such specimens, would let me know of them. There seem to be but few collections of local birds in the county, in fact the only one, if the Tring collection is excluded, that I have seen, is that belonging to the Hon. A. Holland-Hibbert at Munden, near Watford.

I will now turn to the various birds which have occurred in Hertfordshire during the past year, commencing with the species new to the county list. Before doing this, I will just state that

I have not in this paper, as in former years, referred to previous occurrences of the rarer species, as I consider that the list of the birds of Hertfordshire, which will shortly appear in our 'Transactions' (see pp. 84–102), is of a sufficiently recent date to render the former custom unnecessary, at any rate on this occasion.

Egyptian Goose (*Chenalopex ægyptiaca*).—An example of this species was shot in November last at Beech Farm, about 3 miles from St. Albans, by Mr. Pattison, in whose possession it now is. It was an adult male and was preserved by Mr. Spary, of St. Albans, to whom I am obliged for these particulars. I think that there is little doubt that this is an introduced species, but it is of course gradually becoming naturalized in this country. According to Mr. Howard Saunders, there is no authenticated record of this bird in a wild state ever having come north of the Mediterranean.

In the usual way I will now give the notes that I have collected on various birds which are not new to our list, but which will, I think, interest our members. It will be seen that some of these notes do not refer solely to the year 1898, but I always try in my annual report to incorporate such information therein as has not been given in any of the preceding reports.

Blackbird (*Turdus merula*).—Mr. Spary informs me that he has in his possession a cinnamon-coloured variety of this bird, which was obtained at Digswell in 1874. Mr. T. Vaughan Roberts states that the pied blackbird, which was recorded as being in his garden in 1897, was still there last year. A blackbird's nest with eggs was reported in one of the papers as having been found in Hatfield Park in December last.

Redbreast (*Erithacus rubecula*).—A nest of this species containing one egg was found at Sopwell, St. Albans, on 20th February.

Hedge-Sparrow (*Accentor modularis*).—Mr. Spary has a variety of this bird of a cinnamon colour, which was shot near St. Albans in 1896.

Great Tit (*Parus major*).—Mr. A. Sainsbury Verey informs me that he found a great tit's nest in a hole in the ground where a post had been taken up. The hole was about three inches in diameter, and as deep as the length of his arm. Unfortunately wet weather ensuing caused the bird to desert the nest.

Wren (*Troglodytes parvulus*).—A man walking along the railway near Rickmansworth saw a bird fly out of an apparently empty can, but on examination he found a finished wren's nest in it.

Great Grey Shrike (*Lanius excubitor*).—Mr. H. S. Rivers saw a bird of this species at Redricks, near Sawbridgeworth, and watched it for some time.

Pied Flycatcher (*Muscicapa atricapilla*).—On April 25th and the two following days the Hon. A. Holland-Hibbert saw a male pied flycatcher in a plantation by the Colne in his garden at Munden, near Watford, and watched it for some time each day. On each occasion it was catching insects. He did not observe a female with it.

House-Martin (*Chelidon urbica*).—Mr. Rivers informs me that he saw young house-martins in the nest at Bishop's Stortford as late as October 2nd.

Hawfinch (*Coccothraustes vulgaris*). — This bird was again plentiful in the neighbourhood of Berkhamsted, and Mr. Rivers reports that it nested in the neighbourhood of Sawbridgeworth. Mr. A. Sainsbury Verey informs me that it nests regularly near Heronsgate, frequenting orchards at that time and preferring apple or pear trees to nest in. Mr. Spary also states that this bird is not uncommon in the neighbourhood of St. Albans.

Goldfinch (*Carduelis elegans*).—This bird is on the increase in the neighbourhood of Berkhamsted, and Mr. Rivers reports its occurrence frequently near Sawbridgeworth.

Siskin (*Chrysomitris spinus*).—Mr. Rivers informs me that he saw siskins on several occasions at Sawbridgeworth in the early part of the year, and Mr. Lewis reports the occurrence of this species at West End, Essendon, near Hatfield, on March 29th. Mr. Spary writes to me that in the seventies this bird used to visit the neighbourhood of Welwyn in large numbers in the winter, feeding on the cones of the alder-trees there. Mr. Sainsbury Verey also tells me that he has observed this species on two occasions near Heronsgate, and that it used formerly to be common at Elstree Reservoir and also at St. Margarets, near Ware. I am informed by Mr. Harold Proctor that the siskin often comes in the winter to Hunton Bridge, at which time of the year Mr. M. R. Pryor also sees them at Weston Manor.

Mealy Redpoll (*Acanthis linaria*). — Mr. Verey writes to me that in the winter of 1861 he caught a pair of these birds near St. Albans.

Lesser Redpoll (*Acanthis rufescens*). — Early in the year Mr. Rivers saw birds of this species near Sawbridgeworth, and eventually, on July 15th, he saw a pair of them feeding their fledged young on a plum-tree in his grounds. Mr. Westell also informs me that a nest of this species was found near Sopwell by a boy who caught the old bird. This bird Mr. Westell has since seen, and has no doubt whatever about its history. These two records of this species nesting in Hertfordshire are very interesting, inasmuch as they are at present the only two instances that I know, although, probably, the bird nests comparatively often with us. Mr. Sainsbury Verey tells me that the lesser redpoll is a regular visitor to Heronsgate, arriving about the middle of September and often staying till June. Mr. Spary also tells me that he has occasionally seen this species near St. Albans.

Crossbill (*Loxia curvirostra*). — Mr. Rivers informs me that some crossbills were shot during January in a small larch wood at Tharbies Farm, near Sawbridgeworth. He also states that on August 26th he saw a dull-green crossbill feeding on an Austrian pine at Sawbridgeworth. During the first three months of last year I continually saw parties of these birds near Berkhamsted, where I saw some again in September and the two following

months. Mr. Pryor writes to me that a party of crossbills appeared at Weston Manor at Christmas, and stayed for ten days in the neighbourhood.

Cirl-Bunting (*Emberiza cirlus*).—On August 21st I had the pleasure of identifying a cirl-bunting at Hastoe, near Tring. This is the first occasion on which I have recognized this bird in Hertfordshire, although Mr. Howard Saunders states that it is not uncommon on the hills around Tring.

Starling (*Sturnus vulgaris*).—I frequently saw a starling, which had a nearly white tail, in our garden at Berkhamsted in 1898.

Rook (*Corvus frugilegus*).—I saw some of these birds busy with their nests on January 24th in Berkhamsted Castle grounds.

Great Spotted Woodpecker (*Dendrocopus major*).—This bird was very plentiful around Berkhamsted, and Mr. E. P. Thompson, of Elstree, and Mr. Rivers, of Sawbridgeworth, sent me records of its occurrence in those places.

Lesser Spotted Woodpecker (*Dendrocopus minor*).—Mr. E. P. Thompson informs me of the occurrence of this species at Elstree, and I saw it occasionally near Berkhamsted.

Green Woodpecker (*Gecinus viridis*).—Mr. Joseph Nunn writes to me that on November 16th and 18th he saw a green woodpecker in his garden at Royston. He has never heard of the occurrence of the bird in that locality before.

Little Owl (*Athene noctua*).—This bird again frequented the locality from which I had a report of its occurrence in 1897, and again nested there. On this occasion I am sorry to say that it was disturbed and eventually deserted the nest which was placed in a loft of a barn. One of the eggs was sent to Mr. A. E. Gibbs for the County Museum at St. Albans. In 1897 the nest was placed in a hollow tree. In addition to the above occurrence Mr. Sainsbury Verey informs me that a bird of this species was obtained at Bull's Land, Heronsgate, early in 1898, and another at West Hyde later in the year. I am also informed by the head-keeper at Moor Park that during the past year he has on several occasions seen a small owl about the size of a blackbird: these birds no doubt belonged to this species.

Buzzard (*Buteo vulgaris*).—Mr. Alexander Crossman saw a buzzard flying over Earlswood, Cokenach, near Royston, on October 7th.

Common Scoter (*Œdemia nigra*).—A specimen of the common scoter was obtained near Rickmansworth in November.

Stone-Curlew (*Œdicnemus scolopax*).—Mr. M. R. Pryor saw seven of these birds near Ashwell in the middle of September.

Ringed Plover (*Ægialitis hiaticula*).—Six ringed plovers appeared at Tring on May 22nd, and nine on June 4th.

Golden Plover (*Charadrius pluvialis*).—Street saw large parties of these birds at Tring in December.

Oyster-Catcher (*Hæmatopus ostralegus*).—On March 12th Street saw two oyster-catchers at Tring, and two were shot near Rickmansworth in November.

Green Sandpiper (*Totanus ochropus*).—During the month of October a green sandpiper was shot at Newberries, Radlett, by Mr. H. J. Lubbock, in whose possession it now is.

Redshank (*Totanus calidris*).—Some of these birds were seen at Tring on April 6th, and also on May 25th and 26th.

Greenshank (*Totanus canescens*).—Street saw three birds of this species at Tring on April 4th, and also some on May 23rd.

Curlew (*Numenius arquata*).—This bird occurred at Tring in small parties in March, April, and September.

Black Tern (*Hydrochelidon nigra*).—Black terns were seen at Tring on May 27th, and on the following day a large party consisting of this species and common terns appeared there. Four also were seen there on June 26th.

Common Tern (*Sterna fluviatilis*).—Street first saw this species at Tring on May 18th, and a large party arrived on May 27th. The last date on which they were seen there was September 18th. Mr. E. P. Thompson saw one of these birds at Elstree Reservoir on May 15th and several more on May 21st.

Lesser Tern (*Sterna minuta*).—This species occurred at Tring on April 17th and 26th, and also on June 10th and 30th.

Black-headed Gull (*Larus ridibundus*).—A young bird was shot at Heronsgate early in the spring. It was a male. Street also saw five of these birds at Tring on September 24th.

Common Gull (*Larus canus*).—Five gulls of this species appeared at Tring on April 16th and three on the 23rd of the same month, while others were seen there on May 9th, June 20th, and Sept. 5th.

Herring Gull (*Larus argentatus*).—Three herring gulls were reported at Tring on May 12th.

Black-backed Gull (*Larus fuscus* vel *marinus*).—Black-backed gulls appeared at the Reservoirs on May 3rd and 19th. On June 1st one, and on September 12th five birds appeared there, which Street described as large black-backed gulls.

Kittiwake (*Rissa tridactyla*).—A dead bird of this species was picked up by Mr. M. R. Pryor during the severe frost of 1895, but this was not reported at the time.

Great Crested Grebe (*Podicipes cristatus*).—Some of these birds were at Tring Reservoirs on January 29, although they usually do not return there much before the middle of March. Owing to the scarcity of water there were hardly as many pairs as usual nesting at the Reservoirs last year.

Arrival and Departure of Migrants.

Summer Migrants.

Species.		Locality.	Date.	Observer.
Wheatear ..... (*Saxicola œnanthe*)	(Last seen)	Sawbridgeworth	Sept. 1	H. S. Rivers.
Redstart ..... (*Ruticilla phœnicurus*)		Sawbridgeworth	April 17	H. S. Rivers.
	(Last seen)	Sawbridgeworth	Sept. 7	H. S. Rivers.

Species.	Locality.	Date.	Observer.
Nightingale	Hatfield	April 6	T. Brown.
(*Daulias luscinia*)	St. Albans	,, 14	H. Lewis.
	Hitchin	,, 15	A. W. Dawson.
	Watford	,, 16	Mrs. Bishop.
	Berkhamsted	,, 20	E. Mawley.
	Tring	,, 20	J. Street.
	Sawbridgeworth	,, 23	H. S. Rivers.
	Harpenden	,, 27	J. E. Willis.
Whitethroat	Watford	,, 19	C. Worte.
(*Silvia cinerea*)	Sawbridgeworth	,, 24	H. S. Rivers.
(Last seen)	Sawbridgeworth	Sept. 1	H. S. Rivers.
Lesser Whitethroat	Tring	April 22	J. Street.
(*Silvia curruca*)	Sawbridgeworth	,, 27	H. S. Rivers.
Blackcap	Sawbridgeworth	,, 15	H. S. Rivers.
(*Silvia atricapilla*)			
(Last seen)	Little Gaddesden	Sept. 24	A. F. C.
	Sawbridgeworth	,, 25	H. S. Rivers.
Garden-Warbler	Watford	April 27	C. Worte.
(*Silvia hortensis*)			
Sedge-Warbler	Watford	,, 19	C. Worte.
(*Acrocephalus phragmitis*)	Sawbridgeworth	,, 27	H. S. Rivers.
(Last seen)	Sawbridgeworth	Sept. 21	H. S. Rivers.
Reed-Warbler	Tring	,, 20	J. Street.
(*Acrocephalus streperus*)	Watford	,, 22	C. Worte.
Chiffchaff	St. Albans	Mar. 30	H. Lewis.
(*Phylloscopus rufus*)	Watford	April 2	C. Worte.
	Hertford	,, 4	*Herts Mercury.*
	Sawbridgeworth	,, 7	H. S. Rivers.
(Last seen)	Sawbridgeworth	Sept. 8	H. S. Rivers.
	Berkhamsted	,, 28	A. F. C.
Willow-Wren	St. Albans	April 13	
(*Phylloscopus trochilus*)	Sawbridgeworth	,, 14	H. S. Rivers.
(Last seen)	Sawbridgeworth	Sept. 16	H. S. Rivers.
Wood-Wren	Watford	April 30	C. Worte.
(*Phylloscopus sibilatrix*)	Sawbridgeworth	May 4	H. S. Rivers.
Tree-Pipit	St. Albans	April 13	H. Lewis.
(*Anthus trivialis*)	Sawbridgeworth	,, 20	H. S. Rivers.
(Last seen)	Sawbridgeworth	Sept. 21	H. S. Rivers.
Wagtail, Yellow	Tring	April 5	J. Street.
(*Motacilla raii*)			
(Last seen)	Sawbridgeworth	Aug. 28	H. S. Rivers.
Flycatcher, Spotted	Hitchin	April 20	A. W. Dawson.
(*Muscicapa grisola*)	Ashwell	May 2	H. G. Fordham.
	Sawbridgeworth	,, 5	H. S. Rivers.
	Hatfield	May 18	T. Brown.
(Last seen)	Hastoe	Aug. 28	A. F. C.
	Sawbridgeworth	Sept. 10	H. S. Rivers.
Flycatcher, Pied	Munden	April 24	A. H. Hibbert.
(*Muscicapa atricapilla*)			
Swallow	Berkhamsted	,, 6	E. Mawley.
(*Hirundo rustica*)	Hertford	,, 7	*Herts Mercury.*
	Elstree	,, 8	E. P. Thompson.
	St. Albans	,, 11	Mr. Phillips.
	Tring Reservoirs	,, 13	J. Street.
	Hitchin	,, 13	A. W. Dawson.
	Watford	,, 13	C. Worte.
	Hatfield	,, 16	T. Brown.
	Sawbridgeworth	,, 17	H. S. Rivers.
	Harpenden	,, 25	J. E. Willis.
(Last seen)	Broxbourne	Oct. 12	H. P. Waller.

Species.	Locality.	Date.	Observer.
Swallow (Last seen) (*Hirundo rustica*)	Watford	Oct. 14	Mrs. Bishop.
	Berkhamsted	,, 18	A. F. C.
	Sawbridgeworth	Nov. 6	H. S. Rivers.
	Ashwell	,, 11	H. G. Fordham.
Martin, House (Last seen) (*Chelidon urbica*)	Berkhamsted	Oct. 18	A. F. C.
	Sawbridgeworth	Nov. 13	H. S. Rivers.
Sand-Martin (*Cotile riparia*)	Watford	April 8	C. Worte.
	Tring	,, 19	J. Street.
	Sawbridgeworth	,, 24	H. S. Rivers.
Swift (*Cypselus apus*)	Tring	,, 28	J. Street.
	St. Albans	May 2	H. Lewis.
	Sawbridgeworth	,, 4	H. S. Rivers.
	Watford	,, 5	C. Worte.
(Last seen)	Sawbridgeworth	Sept. 1	H. S. Rivers.
Nightjar (*Caprimulgus europæus*)	Berkhamsted	May 11	F. Sharman.
Wryneck (*Iynx torquilla*)	Sawbridgeworth	April 14	H. S. Rivers.
	St. Albans	,, 15	H. Lewis.
Cuckoo (*Cuculus canorus*)	St. Albans	,, 4	J. Boyes, jun.
	Broxbourne	,, 5	H. P. Waller.
	Watford	,, 13	Mrs. Bishop.
	Elstree	,, 14	E. P. Thompson.
	Hatfield	,, 14	T. Brown.
	Harpenden	,, 15	J. E. Willis.
	Hertford	,, 16	*Herts Mercury*.
	Berkhamsted	,, 17	E. Mawley.
	Hitchin	,, 17	A. W. Dawson.
	Sawbridgeworth	,, 17	H. S. Rivers.
	Tring	,, 21	J. Street.
Turtle-Dove (*Turtur communis*)	Watford	,, 26	C. Worte.
(Last seen)	Sawbridgeworth	Sept. 10	H. S. Rivers.
Landrail (*Crex pratensis*)	Watford	April 20	C. Worte.
	Sawbridgeworth	,, 28	H. S. Rivers.
Winter Migrants.			
Fieldfare (Last seen) (*Turdus pilaris*)	Sawbridgeworth	April 2	H. S. Rivers.
(First seen)	Berkhamsted	Oct. 22	A. F. C.
	Sawbridgeworth	Nov. 13	H. S. Rivers.
Redwing (Last seen) (*Turdus iliacus*)	Berkhamsted	Mar. 26	A. F. C.
	Sawbridgeworth	,, 28	H. S. Rivers.
(First seen)	Berkhamsted	Oct. 21	A. F. C.
Grey Wagtail (*Motacilla melanope*)	Berkhamsted	,, 3	A. F. C.
Woodcock (*Scolopax rusticula*)	Berkhamsted	,, 22	A. F. C.

In conclusion I have to thank all my correspondents for the assistance they have given me in supplying materials for this report, and I hope that they will continue to do so in future years. I also hope that others will supply me with notes in order that eventually there may be reports from all parts of the county.

XIX.

METEOROLOGICAL OBSERVATIONS TAKEN IN HERTFORDSHIRE IN THE YEAR 1898.

By John Hopkinson, F.L.S., F.G.S., F.R.Met. Soc., Assoc. Inst.C.E.

Read at Watford, 28th March, 1899.

The meteorological stations, from the records of which this report for the year 1898 has been drawn up, remain the same as before, and the observations have been taken in the same manner. The hour of observation is 9 a.m., and all records are entered to the same day except the maximum temperature and the rainfall, which go into the previous day. At Bennington, Berkhamsted, and St. Albans the shade-temperature thermometers are in Stevenson screens; at Royston and New Barnet they are in Glaisher screens. This accounts for the greater range of temperature shown at these two places.

Table I.—*Results of Climatological Observations taken in Hertfordshire in the Year* 1898.

Stations	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes					
	Mean	Min.	Max.	Range	Min.	Max.			Amount	Days
	°	°	°	°	°	°	%		ins.	
Royston	50·7	42·4	59·0	16·6	21·9	89·0	84	6·7	21·26	149
Bennington	49·9	42·5	57·3	14·8	18·2	89·4	81	7·4	20·27	167
Berkhamsted	50·0	42·0	58·1	16·1	20·5	90·3	81	7·3	19·13	158
St. Albans	50·2	43·1	57·4	14·3	23·3	89·2	81	6·9	19·12	165
New Barnet	49·9	40·1	59·8	19·7	16·0	91·8	80	6·4	18·09	133
County	50·2	42·0	58·3	16·3	16·0	91·8	81	6·9	19·57	155

The year 1898 was very warm and very dry, having a rainfall nearly seven inches below the average for the last half-century. Compared with the average of the ten years 1887–96 the excess in temperature was about two degrees, and the defect in rainfall rather more than five inches, and there were fifteen fewer days of rain. The day temperature was a little more in excess than the night temperature, the mean daily range being rather greater than usual. The relative humidity was a little less than usual, but as the temperature was high the actual amount of moisture in the air was about the average. The sky was a little more cloudy than usual. The mean temperature was about the same as in the year 1893, and the rainfall was half an inch greater than in the year 1887, rain falling on four more days than in that year.

TABLE II.—*Means of Climatological Observations (with Extremes of Temperature) for the Seasons of* 1897–98.

Seasons	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Winter	40·4	34·8	46·1	11·3	15·0	56·9	88	7·4	4·58	33
Spring	45·8	37·1	54·4	17·3	18·0	78·0	80	7·2	5·67	45
Summer	60·4	50·4	70·4	20·0	36·0	88·9	74	6·6	3·83	34
Autumn	52·7	44·5	61·0	16·5	21·0	91·8	84	6·8	5·62	35

The winter of 1897–98 (Dec. to Feb.) was very mild, both days and nights being nearly four degrees warmer than usual. The air was rather dry, the sky rather cloudy, and the rainfall about 5 per cent. less than the average, and on fewer days than usual.

The spring (March to May) was cold, owing almost entirely to the coldness of the days, the daily range of temperature therefore being small. The air was rather humid, the sky cloudy, and the rainfall heavy, being 18 per cent. above the average, and there were more wet days than usual.

The summer (June to August) was rather warm, owing almost entirely to the warmth of the days, the daily range of temperature being greater than usual. The air was rather dry, the sky of average brightness, and the rainfall very small, being 47 per cent. below the average, and there were fewer wet days than usual.

The autumn (Sept. to Nov.) was very warm, the days having a rather greater excess of temperature than the nights, the daily range therefore being greater than usual. The air was rather dry, the sky rather cloudy, and the rainfall small, being 30 per cent. below the average, and there were but few wet days.

We thus had a very mild and rather dry winter, a cold, wet, and gloomy spring, a rather warm and very dry summer, and a very warm and dry autumn. The only cold months were March, May, and June, and the only wet ones were May, October, November, and December, October having, however, a little less than the average rainfall for the ten years 1887–96.

In the following notes on the months a few observations taken at other places than our five meteorological stations are included. The observations of temperature referred to Hertford are those taken at Bayfordbury, and printed in the 'Hertfordshire Mercury.'

JANUARY.—Exceedingly mild, of average humidity, very cloudy, and with a very small rainfall on a small number of days. The mean temperature was 6° above the average, but only 0°·2 above that of January, 1890. The excess was rather more due to the warmth of the nights than that of the days, the daily range being smaller than usual. On the night of the 21st, the minimum temperature was as high as 48° at Berkhamsted, 49° at St. Albans,

TABLE III.—*Means of Climatological Observations (with Extremes of Temperature) taken at Royston, Bennington, Berkhamsted, St. Albans, and New Barnet, during the Year* 1898.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·8	37·1	46·6	9·5	22·5	55·6	90	8·8	·74	9
Feb.	39·9	33·3	46·5	13·2	16·0	56·9	85	6·4	1·08	16
March	39·5	31·8	47·2	15·4	18·0	60·5	83	7·1	1·39	12
April	46·9	36·9	56·9	20·0	18·8	67·6	79	6·8	1·59	12
May	50·9	42·6	59·2	16·6	29·0	78·0	77	7·6	2·69	21
June	57·1	48·1	66·1	18·0	36·0	78·8	75	7·3	1·69	14
July	60·6	50·2	71·0	20·8	36·5	82·0	73	6·7	·90	7
August	63·5	52·8	74·2	21·4	39·7	88·9	75	5·9	1·24	13
Sept.	60·8	48·7	72·9	24·2	27·5	91·8	72	4·9	·40	4
Oct.	52·9	46·4	59·4	13·0	31·5	72·0	88	7·2	2·98	15
Nov.	44·5	38·4	50·7	12·3	21·0	61·0	92	7·4	2·24	16
Dec.	43·5	38·1	49·0	10·9	16·9	55·1	86	7·2	2·63	16
Year	50·2	42·0	58·3	16·3	16·0	91·8	81	6·9	19·57	155

TABLE IV.—*Climatological Observations taken at* LONDON ROAD, ROYSTON. *Latitude:* 52° 2′ 34″ N. *Longitude:* 0° 1′ 8″ W. *Altitude:* 301 *feet. Observer:* HALE WORTHAM, F.R.Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	42·2	37·1	47·3	10·2	28·8	54·9	89	8·8	·76	10
Feb.	39·5	32·3	46·8	14·5	21·9	55·7	84	6·1	·96	11
March	40·0	32·3	47·7	15·4	22·8	60·5	86	7·1	1·55	10
April	48·1	37·5	58·7	21·2	27·1	67·6	87	5·5	2·03	12
May	51·8	42·7	60·8	18·1	34·2	76·0	85	7·4	2·81	21
June	58·2	48·6	67·9	19·3	38·2	77·7	78	6·5	2·13	14
July	61·5	51·0	72·0	21·0	42·9	82·3	80	6·6	1·22	6
August	64·4	53·3	75·5	22·2	44·1	86·8	80	5·4	1·38	11
Sept.	61·4	50·2	72·5	22·3	37·0	89·0	74	4·0	·24	3
Oct.	53·1	46·7	59·6	12·9	35·3	67·6	86	6·9	2·73	16
Nov.	45·2	39·5	50·9	11·4	25·2	60·3	90	7·3	2·40	18
Dec.	42·7	37·1	48·2	11·1	25·2	55·1	85	6·5	3·05	17
Year	50·7	42·4	59·0	16·6	21·9	89·0	84	6·7	21·26	149

50° at Hertford, and 51° at Hitchin, this being the highest minimum recorded there in January since the year 1851. The sky was completely overcast at 9 a.m. for at least two-thirds of the days in the month (for 25 days at St. Albans), and there was very little sunshine, as many days being sunless throughout as were completely overcast in the morning, and the sun not shining on the average for an hour a day. Barometric pressure was unusually high after the first week, when all the rain fell except about a tenth of an inch.

February.—Another mild month, with a rather dry atmosphere, a rather bright sky, and a small rainfall, though but little below the average, and on more than the usual number of days. The days were about as warm as in January, but the nights were nearly 4° colder, the mean daily range of temperature being considerable. On the night of the 21st,* the exposed thermometer on the grass at Berkhamsted registered 17°, and at Hertford 14°; on the 21st of January at the latter place it was 43°. The mean temperature of the 21st of February was about 20° lower than that of the 21st of January. There was a fair amount of bright sunshine—about three times as many hours as in January. A gale of wind was recorded on the 2nd at Berkhamsted and St. Albans. A little snow fell at the beginning of the month, and more towards the end, with some hail. On Sunday evening, the 20th, at a few minutes to 9 o'clock, a large and brilliant meteor was observed by several persons in Hertford and its neighbourhood, and at various places in the south of England, even so far away as Devizes.

March.—Rather cold, being colder than February, and decidedly colder than January, with a rather dry atmosphere but a cloudy sky, and with less than the average rainfall on rather fewer days than usual. The days were warmer than in either January or February, but the nights were much colder, the mean night temperature being more than 5° colder than in January, and the mean daily range 6° greater. The exposed thermometer at Berkhamsted frequently registered 13° below freezing, and at Hertford it sank to 15° (or 17° of frost) on the 13th, this being the coldest night in the month. There were about as many hours of bright sunshine as in January and February together. Mr. Mawley says that at Berkhamsted the sun shone brightly on the 20th for ten hours, which, with one exception, is the highest recorded there for the past thirteen years for any day so early in the year. Snow fell at the beginning and towards the end of the month; on the morning of the 25th to the depth of four or five inches.

April.—A little warmer than usual, with a rather humid atmosphere, a rather cloudy sky, and with more than the average rainfall, but on only the usual number of days. The excess in temperature was chiefly due to the warmth of the days, the daily range being considerable. On the night of the 4th the minimum

* This was the day of the great snowstorm in the west of England. See 'Meteorological Magazine,' vol. xxiii, pp. 17–20.

TABLE V. — *Climatological Observations taken at* BENNINGTON HOUSE, BENNINGTON. *Latitude:* 51° 53′ 45″ N. *Longitude:* 0° 5′ 20″ W. *Altitude:* 407 *feet. Observer:* REV. J. D. PARKER, LL.D., F.R.Met.Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·8	37·3	46·2	8·9	26·8	55·6	91	8·8	·58	10
Feb.	39·8	33·5	46·2	12·7	18·2	55·9	85	6·8	·91	18
March	39·3	32·5	46·1	13·6	27·1	56·1	84	7·4	1·37	13
April	46·7	37·8	55·5	17·7	28·5	64·8	77	7·8	1·72	13
May	50·2	42·6	57·8	15·2	34·4	70·6	76	8·1	3·18	22
June	56·0	47·9	64·2	16·3	38·0	73·4	75	7·8	2·21	15
July	59·9	50·5	69·2	18·7	44·1	79·7	72	8·1	1·13	9
August	62·7	53·0	72·4	19·4	42·0	84·9	74	6·0	1·16	13
Sept.	61·1	50·2	72·1	21·9	35·0	89·4	70	5·7	·29	4
Oct.	53·0	47·1	58·9	11·8	34·1	69·6	86	7·8	3·16	14
Nov.	44·5	38·9	50·1	11·2	25·5	59·3	93	8·0	1·97	19
Dec.	43·8	38·7	48·9	10·2	25·3	55·8	88	7·1	2·59	17
Year	49·9	42·5	57·3	14·8	18·2	89·4	81	7·4	20·27	167

TABLE VI.—*Other Meteorological Observations taken at Bennington by the Rev. Dr. Parker.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	30·349	41·1	40·0	41·7	42·3	1	22	31	7·3	19
Feb.	29·970	38·5	36·8	40·2	41·4	2	12	98	9·0	3
March	·930	39·3	37·3	39·7	40·6	3	13	120	10·6	4
April	·956	47·1	43·8	46·5	46·3	4	11	170	12·9	3
May	·872	51·2	47·5	51·4	50·9	0	17	164	11·8	4
June	30·020	57·1	53·0	57·5	56·7	1	15	179	14·7	3
July	·132	60·6	55·7	61·9	61·3	1	13	226	14·1	0
August	·044	63·4	58·8	62·9	62·5	4	9	228	12·7	2
Sept.	·139	61·3	56·1	61·7	62·2	10	8	234	12·0	1
Oct.	29·877	52·8	50·8	53·8	55·1	4	16	97	10·5	10
Nov.	·892	43·8	43·0	47·3	49·2	3	19	82	8·6	10
Dec.	30·095	43·0	41·5	43·9	45·2	4	16	59	6·7	11
Year	30·023	49·9	47·0	50·7	51·1	37	171	1688	14·7	70

temperature was 28°·4 at St. Albans, 25° at Berkhamsted, and 24° at Hertford, the exposed thermometer on the grass registering 20° at Berkhamsted, and 16° at Hertford. The 23rd was also a cold night, the minimum shade temperature being 31°·2 at St. Albans, 29° at Berkhamsted, and 27° at Hertford. There was about the usual amount of bright sunshine, and on only two or three days in the month was no sunshine recorded. The temperature was very variable.

May.—A cold month, with a humid atmosphere, a cloudy sky, and a very heavy rainfall on a large number of days. The defect in temperature was entirely due to the coldness of the days, the mean daily range of temperature being much smaller than usual. The duration of bright sunshine was considerably less than usual. On no day was the sky quite cloudless at 9 a.m. at Bennington, on only one day at St. Albans, and two days at Berkhamsted, while it was completely overcast at the same hour on 15 days at St. Albans, 16 at Berkhamsted, and 17 at Bennington. There was a south-westerly gale on the 11th reported from Berkhamsted and St. Albans, which reached its height about noon. The temperature was very variable, the minimum in the shade varying from one degree above freezing at several places to as high as 52° at Hertford. On the 19th the maximum in the shade was 49° at Berkhamsted, 49°·8 at St. Albans, and 51° at Hertford; on the 23rd it was 71°·9 at St. Albans and 74° at Berkhamsted and Hertford.

June.—Another cold month, the coldest June for the last twelve years except that of 1892, of average humidity, with a very cloudy sky, and with an average rainfall, but on more than the usual number of days. The defect in temperature was almost entirely due to the coldness of the days, the daily range of temperature being less than usual. There was considerably less than the usual amount of bright sunshine, and at Bennington and Berkhamsted only one day was quite cloudless at 9 a.m. The mean rainfall at our five meteorological stations was exactly the same as the mean for the whole of the 48 rainfall stations in the county, but there was a great variation between that of one station and another, Royston and Bennington having more than twice as much as Berkhamsted, the smallest fall in the county being registered at Rosebank.

July.—Of average temperature, with a rather dry atmosphere, an average amount of cloud, and a very small rainfall on very few days. The nights were colder than usual and the days rather warmer, giving a considerable daily range of temperature. The rainfall was about one-third the average, and on half the usual number of days. The duration of bright sunshine was considerably greater than usual, and not a single day was quite sunless. There was an absolute drought of 16 days, July 2 to 17, at Berkhamsted, St. Albans, and New Barnet, but a little rain fell on the 9th at Royston and Bennington. Thunder was heard at St. Albans on the afternoon of the 27th, and there was a thunderstorm there on the

TABLE VII. — *Climatological Observations taken at* ROSEBANK, BERKHAMSTED. *Latitude :* 51° 45′ 40″ N. *Longitude :* 0° 33′ 30″ W. *Altitude :* 400 *feet. Observer :* EDWARD MAWLEY, Sec. R. Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	42·0	37·3	46·7	9·4	26·6	55·1	91	9·4	·81	10
Feb.	40·3	34·2	46·3	12·1	20·5	54·9	88	6·8	1·20	19
March	39·1	31·6	46·7	15·1	25·1	55·5	83	7·5	1·59	13
April	46·7	36·8	56·5	19·7	25·1	66·6	76	7·2	1·46	11
May	50·4	42·5	58·4	15·9	32·9	73·8	74	7·6	2·28	20
June	56·7	47·9	65·4	17·5	39·5	75·2	73	7·5	1·06	13
July	60·5	49·8	71·2	21·4	41·1	81·1	68	6·8	·60	7
August	63·0	52·5	73·5	21·0	43·3	84·4	74	6·3	1·25	12
Sept.	60·5	48·0	73·0	25·0	30·3	90·3	71	5·8	·71	4
Oct.	52·4	46·1	58·6	12·5	36·8	70·9	90	7·8	2·78	15
Nov.	44·7	38·5	50·9	12·4	24·8	61·0	94	8·1	2·71	15
Dec.	44·3	39·0	49·7	10·7	24·1	56·1	88	7·1	2·68	15
Year	50·0	42·0	58·1	16·1	20·5	90·3	81	7·3	19·13	158

TABLE VIII. — *Other Meteorological Observations taken at Berkhamsted by Mr. Mawley.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	30·336	41·1	40·1	41·5	42·2	1	23	22	5·6	22
Feb.	29·963	38·4	37·0	40·2	41·7	1	9	68	9·2	8
March	·914	38·7	36·7	40·2	41·3	3	13	98	10·0	8
April	·933	47·0	43·7	48·4	47·7	5	9	153	10·8	2
May	·848	51·2	47·3	53·2	52·4	2	16	145	13·3	4
June	30·008	57·4	52·8	59·0	57·9	1	11	156	14·1	3
July	·129	61·5	55·9	63·1	62·5	1	9	207	13·5	0
August	·033	62·9	58·3	64·7	64·3	3	8	202	12·0	1
Sept.	·127	60·8	55·8	63·1	64·2	8	4	207	10·8	0
Oct.	29·854	52·0	50·6	53·6	55·8	4	17	72	9·8	12
Nov.	·866	43·1	42·4	46·5	49·6	3	17	59	7·0	11
Dec.	30·077	43·3	41·8	43·2	45·2	3	13	39	4·5	14
Year	30·007	49·8	46·9	51·4	52·1	35	149	1428	14·1	85

afternoon of the 28th, with 0·28 inch of rain. On the 14th there was a difference between the maximum and minimum temperature in the shade of 28° at St. Albans, 32° at Berkhamsted, and 34° at Hertford; and on the 31st the difference was still greater, being 31° at St. Albans, 36° at Berkhamsted, and 39° at Hertford.

August.—A very warm month, with a little less than the average humidity, a rather bright sky, and a small rainfall, but on nearly the usual number of days. The excess in temperature was chiefly due to the warmth of the days, their average being exceeded by nearly 5°; the daily range was therefore great. The rainfall was rather less than half the average. It was the warmest August for the last twelve years except that of 1893. The duration of bright sunshine was nearly as much above the average as it was in July, but one or two days were sunless. The warmest period was from the 11th to the 23rd, when the maximum temperature in the shade was never less than 75° at either Berkhamsted, St. Albans, or Hertford. Thunderstorms were frequent between the 15th and 23rd. Between 3 and 4 a.m. on the 16th there was a severe one at St. Albans, with but little rain; at Berkhamsted, however, half an inch of rain fell during this storm, and for five minutes it was falling at the rate of more than an inch and a half per hour.

September.—An exceedingly warm month, with a very dry atmosphere, a very bright sky, and much the smallest rainfall of any month in the year, on very few days. The excess of temperature was almost entirely due to the warmth of the days, the mean maximum shade temperature being nearly 8° higher than the average; the daily range was therefore very great, and during the last twelve years was only exceeded in April and June, 1893. This is the warmest September in this period except that of 1895, the temperature of which was practically the same, and of the same character as to the days and nights. There was an absolute drought of 18 days, Aug. 31 to Sept. 17, at Royston, and of 19 days, Aug. 30 to Sept. 17, at Berkhamsted, St. Albans, and New Barnet. The aggregate rainfall for the first 28 days in the month was less than a tenth of an inch. There was an unusual amount of bright sunshine, but the duration was nearly as great in September, 1895. At all stations the maximum temperature in this month was the highest in the year. The 8th and 17th were much the hottest days.

October.—Another very warm month, but with a rather more humid atmosphere than usual, a cloudy sky, and the heaviest rainfall in the year, though only about the average, and on the average number of days. Unlike September, the nights were unusually warm, the mean minimum shade temperature being nearly 7° above the average, and 3° higher than in any other October for the last twelve years; the daily range was therefore small, in fact little more than half that of September. There was considerably less bright sunshine than usual. On the 17th and 18th, in the middle of a period of heavy rainfall,

TABLE IX. — *Climatological Observations taken at* THE GRANGE, ST. ALBANS. *Latitude:* 51° 45′ 9″. *Longitude:* 0° 20′ 7″ W. *Altitude:* 380 *feet. Observer:* JOHN HOPKINSON, F.R.Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·7	37·5	46·0	8·5	28·1	54·4	92	9·5	·75	10
Feb.	39·9	34·4	45·4	11·0	23·3	54·9	86	5·6	1·10	17
March	39·8	33·0	46·6	13·6	27·5	55·1	82	6·7	1·36	14
April	46·9	38·2	55·6	17·4	28·4	64·8	79	7·0	1·48	12
May	50·9	43·7	58·0	14·3	36·3	72·9	75	7·5	2·57	22
June	56·9	49·3	64·5	15·2	39·4	72·5	73	7·0	1·76	15
July	60·5	51·6	69·5	17·9	44·0	79·1	72	6·2	1·00	8
August	63·5	54·3	72·7	18·4	47·0	85·8	75	6·2	1·19	15
Sept.	61·4	50·4	72·4	22·0	37·0	89·2	70	5·2	·42	4
Oct.	52·9	47·0	58·8	11·8	36·2	70·3	90	6·6	2·83	14
Nov.	44·5	38·9	50·1	11·2	26·2	58·2	93	7·8	2·28	17
Dec.	43·8	38·7	48·9	10·2	26·0	56·4	86	7·9	2·38	17
Year	50·2	43·1	57·4	14·3	23·3	89·2	81	6·9	19·12	165

TABLE X. — *Climatological Observations taken at the* GAS WORKS, NEW BARNET. *Latitude:* 51° 39′ 5″ N. *Longitude:* 0° 10′ 15″ W. *Altitude:* 212 *feet. Observer:* T. H. MARTIN, Assoc. M. Inst. C.E.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·5	36·2	46·9	10·7	22·5	55·5	88	7·7	·80	6
Feb.	38·8	31·9	47·6	15·7	16·0	56·9	84	6·6	1·22	15
March	39·1	29·6	48·7	19·1	18·0	59·0	81	6·6	1·06	9
April	46·2	34·0	58·3	24·3	18·8	66·8	76	6·4	1·28	10
May	51·4	41·6	61·3	19·7	29·0	78·0	77	7·2	2·60	19
June	57·5	46·5	68·4	21·9	36·0	78·8	76	7·5	1·28	12
July	60·7	48·2	73 2	25·0	36·5	81·9	71	5·8	·56	6
August	63·9	50·7	77·1	26·4	39·7	88·9	72	5·4	1·24	12
Sept.	59·7	44·9	74·6	29·7	27·5	91·8	75	3·8	·32	3
Oct.	52·8	44·9	60·8	15·9	31·5	72·0	87	7·1	3·42	15
Nov.	43·8	36·0	51·5	15·5	21·0	60·5	88	5·6	1·85	12
Dec.	43·0	37·0	49·1	12·1	16·9	57·8	85	7·3	2·46	14
Year	49·9	40·1	59·8	19·7	16·0	91·8	80	6·4	18·09	133

barometric pressure was unusually low. At St. Albans the minimum shade temperature was within 9° of freezing on only four nights (2nd, 9th, 11th, and 12th) and within 7° on one night (11th); at Berkhamsted it was within 7° of freezing on four nights (2nd, 9th, 11th, and 31st), and within 6° on two (2nd and 11th). The usual October gales were absent.

November.—Mild, with a humid atmosphere, a sky of average brightness, and rather less than the average rainfall, but on the usual number of days. The excess of temperature was a little more due to the warmth of the days than to that of the nights, the daily range being rather greater than usual. The duration of bright sunshine was less than usual, and on three days no sunshine at all was recorded. At St. Albans the sky was completely overcast at 9 a.m. on the unusually large number of 20 days. This was partly due to the prevalence of fog in the earlier part of the month, fogs being recorded at 9 a.m. on every day from the 6th to the 12th, and on the 14th, and they were so dense that on three days during this period the precipitation from them was measured as 0·01 inch of rain. The first snow of the winter fell on the 23rd, and on the 28th snow laid on the ground for a short time to the depth of an inch. About two inches of rain (including a little snow) fell during the last ten days in the month, being the wettest ten consecutive days since September, 1896.

December.—Very mild, with an unusually dry atmosphere, a sky of average brightness, and a rather heavy rainfall, but only on the usual number of days. Both the nights and the days were between 6° and 7° warmer than the average, the daily range being about the same as usual. This is the warmest December for the last twelve years, the nearest approach to it being the December of 1894, which was 3° colder. The early part of the month was the wettest, but the 27th and 31st were very wet days. No snow fell. The duration of bright sunshine was about the average. There was a severe gale on Tuesday morning the 27th, with hail and heavy rain. At Hitchin boughs were broken off trees, stacks unthatched, and sheds unroofed. At St. Albans the heaviest rain came after the height of the gale, and much damage was done to farm produce. Hertford suffered severely, a chimney-stack being blown down, slates being blown off roofs, and branches broken off trees; a large elm, also, was broken off a few feet from the ground. Much damage was also done at Hoddesdon, houses, etc., suffering, and several trees being blown down.

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VOL. X. PART 5.

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The objects of the Society are:—1. The investigation of the Meteorology, Geology, Botany, Zoology, Ethnology, Pre-Norman Archæology, and Topography of the County of Hertford. 2. The publication of the results of such investigation made by its Members. 3. The dissemination amongst its Members of information on Physics and Biology. 4. The formation of a Library of works on Natural History, and of a Museum illustrative of the Geology, Botany, and Zoology of the County (the Vertebrata excepted). 5. The discouragement of the practice of removing rare plants from the localities of which they are characteristic, and of exterminating rare birds, fish, and other animals.

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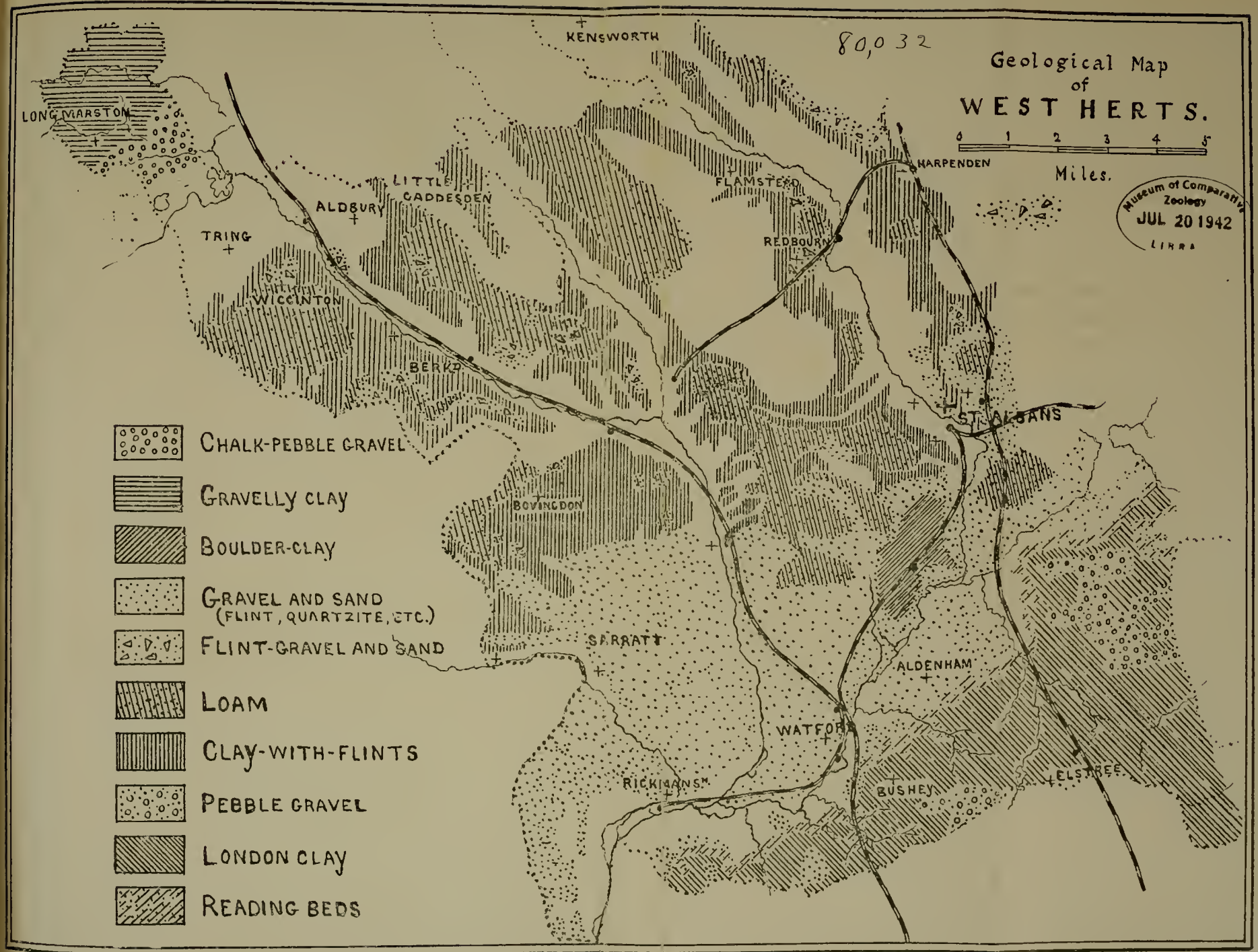

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XX.

THE GRAVELS, SANDS, CLAYS, AND LOAMS OF WESTERN HERTFORDSHIRE.

80,032

By T. E. Lones, M.A., LL.D., B.Sc.

Read at Watford, 28th November, 1899.

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PLATE III.

In that part of the County which lies west of a line drawn through Harpenden and St. Albans there are extensive gravelly, sandy, and clayey deposits which rest upon the Cretaceous or the Tertiary formation. These deposits may be theoretically separated into two series, which merge into each other, and which were deposited respectively before and after the time when certain mammals, such as the musk-sheep, cave-hyæna, woolly rhinoceros, and straight-tusked elephant, became extinct in this country. The former series, with which alone this paper is intended to deal, includes the Glacial Drifts and other beds formed at a time when the physical geography and climatic conditions of the district were very different from what they are now.

There is a close connection between the physical features of a country and the nature and distribution of the deposits occurring over its area, and for this reason a generalized account of the physical features of Western Hertfordshire may serve a useful purpose. In the north are many Chalk hills, which are in places more than 600 feet above mean sea-level, and which form part of the Chiltern Range; these hills occur more especially in the Tring, Aldbury, and Little Gaddesden districts. In the southern part is a low-lying range formed by the Tertiary beds which end off near Rickmansworth, Watford, and Shenley; this range is rarely more than 400 feet above mean sea-level, its average height being about 300 feet. The part of the County between the Chiltern Hills on the north and this low-lying range on the south is gently undulating, and is intersected by comparatively wide and shallow valleys in which flow the River Colne and its tributaries the Ver, Gade, and Chess. It is over this undulating tract of country, with its charming combination of hill and vale, woodland and meadow, that the gravels, sands, clays, and loams described in this paper almost entirely occur.

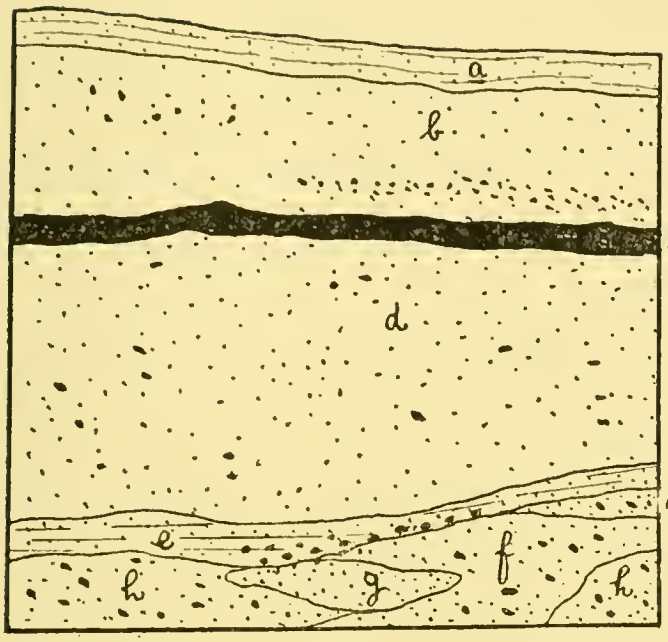
These beds present several important characteristics. Firstly, they are exceedingly variable, a section at one place being usually very different from another at no great distance. Sections 1 and 2 (p. 155), taken in a gravel-pit on the west side of Aldenham, show how rapidly some of the beds thin out and are replaced by others which thin out in turn. The distance between the sections was less than 9 feet. Secondly, as a general rule, the beds are unfossiliferous in the proper sense of the word; fossils occur in some of the deposits, but they are derived and do not

represent the life of the period during which the beds were deposited. This general absence of fossils greatly increases the difficulties of correlating the beds. Thirdly, many of the materials of the deposits, their sands, loams, flints, and well-rounded flint-pebbles, closely resemble the corresponding rocks found in the Cretaceous and Tertiary formations. The sands of the lowest bed shown in the Aldenham sections are, for instance, scarcely distinguishable from some of the sands of the Reading Beds at Watford Heath and Harefield. The deposits are, in all probability, to a large extent a result of the denudation of vast Chalk and Tertiary beds which once existed over most of the County, but have long since disappeared. Lastly, the various deposits of gravel, sand, loam, and clay are distributed over the County in a way so irregular and disconnected that, in ascertaining the relative ages of the beds, the valuable test of superposition can only be applied occasionally and partially.

A series of beds so variable, unfossiliferous, and apparently disconnected cannot be satisfactorily correlated so as to allow a good chronological classification to be made. Such a classification would, for some purposes, be valuable, and would be welcomed by geologists, but for practical purposes a classification based on mineralogical composition is, perhaps, more useful. The following table shows a classification of this kind, and gives the names of a few places where the several beds are well exhibited :—

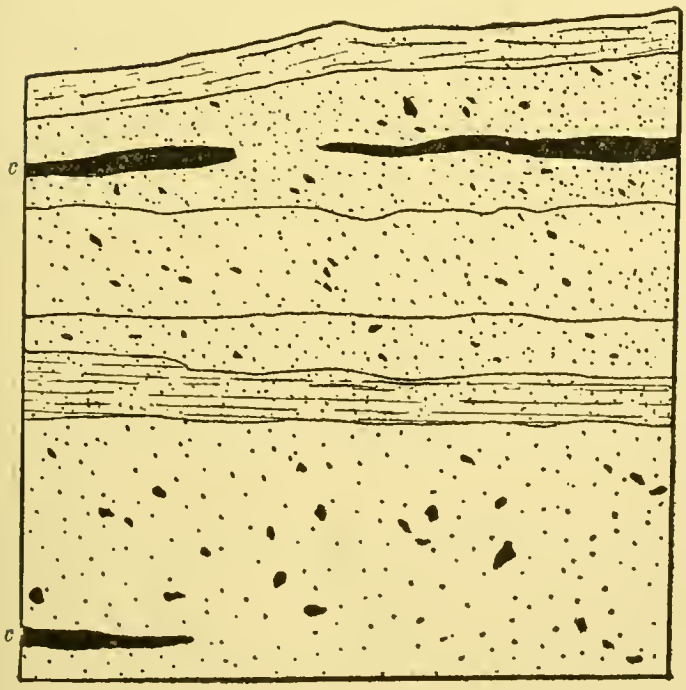
Names of the Beds.	Localities.
1. Clay-with-flints	Wigginton, Frithesden.
2. Loam, sometimes thick and clear enough to be worked profitably as brick-earth	Leverstock Green, Champneys, Potten End.
3. Flint-Gravel and Sand	Wigginton, Couters End.
4. Pebble-Gravel	Bushey Heath.
5. Gravel and Sand, containing pebbles of quartzite, quartz, flint, etc.	Watford, Aldenham, Sopwell, etc.
6. Boulder Clay	Bricket Wood.
7. Gravelly Clay	Marston Gate.
8. Chalk-Pebble Gravel	Gubblecote.

The distribution of these beds is shown more clearly upon the accompanying map, which is not intended to be a finished map, but one from which such a map might be made. That part which shows places lying south of the latitude of Berkhamsted and St. Albans is similar, with the exception of a few alterations, to the corresponding part of the excellent Drift map published by the Geological Survey; the rest of the map is new. A few of the blank spaces on the map represent areas which I have not surveyed sufficiently, but most of them show parts which are not covered by deposits treated of in this paper.



a. Soil.
b. Brown sandy gravel.
c. Manganese bed.
d. Red sandy gravel.
e. Brown loam.
f. Brown gravelly loam.
g. Brown sand.
h. Yellow sandy gravel.

Section 1.—Gravel Pit, Aldenham.



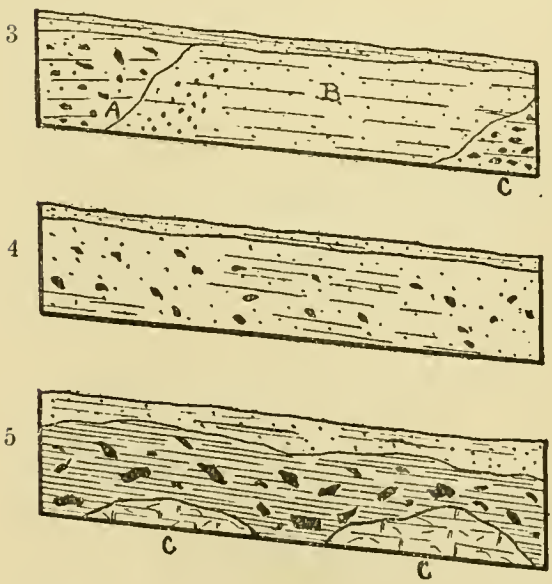
a. Soil.
b. Brown sandy gravel.
c. Manganese beds.
d. Red sandy gravel.
e. Yellow sandy gravel.
f. Brown loam.
g. Yellow sandy gravel.

Section 2.—In the same Pit.

Clay-with-Flints.

In the year 1861 Mr. Whitaker, a past President of this Society, applied the term "clay-with-flints" to a deposit of stiff brown or reddish clay containing large unworn flints, and occurring very irregularly upon the Upper Chalk. This clay-with-flints can be seen at many places on the higher parts of the undulating country before referred to, and especially during an ascent from one of the river-valleys towards the summit of the neighbouring Chalk hills. The clay does not, in general, occur in the lower parts of the valleys, but may be seen over a strip of country of variable width as soon as a certain height has been reached. Thus, anyone ascending the eastern side of the picturesque hill on which Wigginton stands, may see the clay-with-flints as soon as a height of about fifty feet above the Tring road has been attained. Sections 3, 4, and 5 represent beds exposed near Wigginton, at different heights. The clay-with-flints is shown in the portion marked B on Section 5. There is a marked relationship between the contours of the country and the distribution of the clay-with-flints, and this fact has been utilized in drawing some of the boundaries of the deposit on the map.

Sections 3, 4, & 5.—Near Wigginton.



Soil.
A. Brown clayey gravel.
B. Red brick-earth.
C. Brown clayey gravel.

A. Soil.
B. Coarse gravel, sandy or clayey.

A. Soil.
B. Clay-with-flints.
C. Chalk.

The colour of the clay-with-flints is usually a deep reddish-brown, passing near the junction with the Chalk into a darker brown or a nearly black shade. This darkness of colour is mainly due to the presence of oxide of manganese, as a simple chemical analysis will show. The clay contains unworn flints, which appear as if they had been directly derived from the Chalk, and it is often mixed with loam and flint-pebbles probably derived from overlying beds which have been denuded away. In many places

the clay is intimately associated with the deposits of loam, as is clearly seen in Section 3, showing the beds east of Wigginton. Its thickness is very variable.

The question of the origin of the clay-with-flints has been a cause of much speculative reasoning. The general belief is that the deposit is largely the result of the solution of a portion of the Upper Chalk by rain or other waters containing carbonic and other acids. This explanation, put forward by Sir C. Lyell, Sir Joseph Prestwich, and Mr. W. Whitaker, appears to be the best yet offered. Several reasons may be adduced in support of the theory, but want of space does not allow of these being discussed. When moist, the clay is plastic or adhesive like other clays, but there is a peculiarity about the normal clay-with-flints; its adhesiveness is of an unpleasant, greasy nature, such as might be due to the presence of gelatinous silica. Now when chalk is dissolved by means of very dilute hydrochloric or other acid, a fawn-coloured residue is left, and this, after being washed, has an unpleasant, greasy adhesiveness, very similar to that possessed by a normal specimen of clay-with-flints. By incorporating small quantities of oxide of iron with such a residue, an artificial "clay," undistinguishable from a normal sample of clay-with-flints, may be prepared. This shows that dissolution of the chalk is a *possible* cause.

Before closing this partial description of the clay-with-flints, an account of the mineral composition of two samples of the clay may be of interest. The weights of the constituents are given in grammes. A striking feature about the Bovingdon sample is the presence of a comparatively large amount of muscovite or potash-mica, there being numerous glistening white plates of that mineral.

Mineral Composition of Clay-with-Flints.

Locality.	Impalpable clayey matrix.	Quartz.	Flint.	Muscovite.
Bovingdon	1·73	0·43	1·3	0·04
Felden	0·88	0·12	0·48	Traces.

Loam or Brick-earth.

Extensive deposits of loam occur over many parts of the area where the clay-with-flints is found, and the association of the two deposits is sometimes so intimate that it is difficult to decide where one deposit begins and the other ends. The loam is essentially a mixture of sand and clay in various proportions, but it often contains flint-pebbles, blocks of the well-known Hertfordshire pudding-stone, and unworn flints which are sometimes very large, as in the beds at Champneys, Leverstock Green, and Berkhamsted Common. The flint-pebbles are often well rounded, and must have been derived from Tertiary beds.

The beds of loam vary greatly in thickness, there being only thin cappings in some places, while in others the loam is thirty or more feet thick. At Leverstock Green, Woodlane End, Bennett's End, Champneys, Berkhamsted Common, Bernard's Heath, and some

other places, the beds of loam or brick-earth are largely used in making bricks. In the Hemel Hempstead district, where Tertiary clays and sands are also worked for the same purpose, the loam is of great thickness, of good colour, and fairly free from pebbles or flints. The bricks manufactured from this brick-earth are of excellent quality, of uniform colour, and of regular shape.

The loams are usually bright red, reddish-grey, reddish-brown, or brown, the colours being often so distributed as to produce a mottled appearance, but this mottling is usually not well defined. Occasionally the variation of colour is accompanied by a somewhat stratified appearance, as shown in Section 6, taken in a brickyard at Champneys.

Section 6.—At Champneys.

A. Soil.

B. Brown brick-earth.

C. Brick-earth with many flints.

D. Brick-earth, showing a coarse stratification.

E. Dark brown brick-earth.

Generally speaking, the loams are unfossiliferous, but Sir John Evans discovered an impression of a small leaf in loam at Woodlane End, as stated in Whitaker's 'Geology of London,' vol. i, p. 290.

Much doubt exists as to the relative ages and the modes of formation of the various deposits of loam. Some beds in the southern part of the County are closely associated with the Glacial Drift which will be described further on, and were perhaps deposited at the same period as the Drift.

Flint-Gravel and Sand.

The next beds which will be described are those shown on the map as flint-gravel and sand. They occur as isolated patches over the higher parts of the undulating country previously described; in many cases the beds are intimately associated with the beds of loam occurring over the same high ground. Some of the beds are similar to those described by Mr. Whitaker as plateau gravel.

The beds usually consist of sands mixed with unworn flints, subangular flints, and flint-pebbles. In some localities, as at Box Lane, Wigginton, and Markyate Street, the beds of gravel and sand are thin, while in others, as at Nomansland and Couters End, they are 12 feet or more in thickness. These gravels and sands are probably of different ages and were deposited under various conditions. Those near Wigginton, at Box Lane, and in some parts of Berkhamsted Common, are associated in such a way with the beds of loam occurring there as to indicate that they were formed at the same time, as local variations of such beds. A few deposits, like the one near Markyate Street, would appear to have resulted from the subaërial denudation of areas which long remained above sea-level in consequence of their being much higher than the neighbouring submerged districts. My survey of the higher parts of the undulating country already described has led me to believe that subaërial denudation has played not only an important but a very great part in the formation of the superficial deposits covering such areas. The deposits occurring at Nomansland and near Redbourn may be old river-gravels. But whatever may have been the agencies by which the flint-gravels and sands were formed, the composition of these high-lying beds shows that most of their component materials have not travelled far from their parent deposits.

Pebble-Gravel.

The pebble-gravel, of which two undoubted beds are shown on the map, is very different in mineral composition from the gravels described above. It has been so named because it contains an exceptionally large number of well-rounded pebbles of flint and quartz. The larger pebbles are usually of flint and the smaller ones of quartz, the number of small quartz-pebbles and grains being so great as to give, in some cases, a greyish-white colour to the matrix. There is a similar deposit near Bedmond, judging from the presence of numerous quartz-pebbles there, but this deposit has not been shown on the map.

With regard to the age and mode of origin of the pebble-gravel, Mr. Whitaker considers it to be the oldest drift-bed of this district, and Professor McKenny Hughes regarded it as being, in all probability, a marine deposit. The truth of both these views is strongly supported by the evidence.

Gravel and Sand (flint, quartzite).

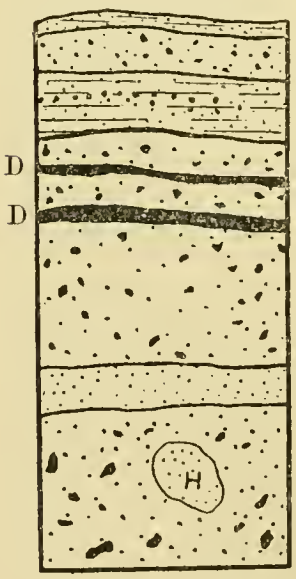
The gravels and sands, often associated with beds of loam, which are shown on the map as occupying most of the low-lying part of the undulating country previously described, are of considerable economic value, since they furnish well-weathered and tough road-material, and an almost inexhaustible supply of sand and gravel for building purposes. These deposits, classed as Middle Glacial by Mr. S. V. Wood, and as "gravels of the lower plain" by Professor

Hughes, are generally regarded as being older than the Bricket Wood boulder-clay, and younger than the pebble-gravel already described.

The beds of gravel and sand vary very greatly in thickness, even in different parts of the same area, and they almost always rest upon a very uneven surface of the Upper Chalk, or upon clay-with-flints of variable thickness which covers the Chalk. In several places near Vicarage Road, Watford, the beds are as much as 30 feet thick; at Brightwells a thickness of about 9 feet is shown; and near Bushey Hall the beds are about 15 feet thick.

The mineral composition of the beds is so varied, and to a large extent characteristic, that a somewhat detailed description of it will be given. For this purpose, it will be convenient to imagine a large quantity of the gravels and sands of average composition to be graded or sorted into three lots, and then to describe these lots separately, beginning with the coarsest. In this way let the gravels and sands be graded by means of two rings, whose diameters are six inches and three-sixteenths of an inch respectively. The coarsest of these portions forms a comparatively small fraction of the whole, and is mainly composed of large unworn flints and blocks of greywether sandstone and Hertfordshire pudding-stone. Some of the blocks of greywether sandstone are very large, and one about 4 feet long is exposed in a gravel-pit near Vicarage Road, Watford.

Section 7.—Gravel Pit, Watford.



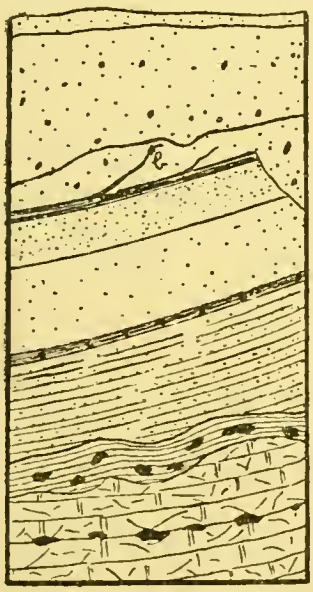
A. Soil.
B. Flint gravel.
C. Brown loam, with pebbles.
D. Manganese beds.
E. Gravel with large flints and quartzite pebbles.
F. Light-brown sand.
G. Gravel with large flints and quartzite pebbles.
H. Brown sand.

The second portion of the graded material consists chiefly of angular and subangular flints, flint-pebbles, quartz-pebbles, pieces of coarse sandstone or grit, and well-rounded pebbles of brown, reddish-grey, red, purplish-red, and nearly black quartzite. Occasionally specimens of chalcedony, sandstone (probably from the Lower Greensand) with a large quantity of limonite as

cementing material, felspar-porphyry, lydian-stone, chrysoprase, and pseudomorphs of limonite after jasper, are also met with. The finest portion, or matrix, consisting of grains less than three-sixteenths of an inch in diameter, is mainly composed of angular and subangular pieces of flint and quartz, rounded quartz-pebbles, and pieces of limonite. Of course the composition of the gravels varies considerably, and constituents which form a very marked feature at one locality may be present only in small quantity at another; thus the presence of numerous large quartzite- and quartz-pebbles is a marked feature in the lower parts of the gravel near the southern end of the Watford Tunnels, and some of the gravels near Bushey are characterized by the presence of a large number of well-rounded flint-pebbles. The number of these pebbles, derived from the Tertiary beds, usually increases considerably as the Tertiary escarpment is approached.

The beds of gravel are often associated with beds of loam, clean and often well-washed sand, and occasionally with very small locally-developed layers of blue clay, which is very similar in appearance to boulder-clay. The general character of the deposits is shown in Sections 1, 2, 7, and 8, taken in the Watford, Aldenham, and St. Albans districts. In all these cases an irregular but decided stratification is clearly shown, indicating that the beds were deposited from running water.

Section 8.—Bernard's Heath, St. Albans.



A. Soil.

B. Gravel with many flint pebbles.

b. Thin bands of manganese oxide.

C. Manganese bed.

D. Variegated sands.

E. White sand.

F. Clay with flint pebbles.

G. Brown and green loams.

Reading Beds.

H. Brown clay-with-flints.

I. Chalk.

Before concluding this description of the composition of the beds, an account will be given of some thin and locally-developed beds of exceptional character. Some of these are shown in Sections 1, 2, 7, 8, and 10, from the Watford and St. Albans districts. These deposits, which I have marked on the sections as the "manganese beds," are usually black in colour, and are better

developed in the lower portions of the gravels. By washing a sample of these deposits so as to remove accompanying flints and pebbles, a residue may easily be obtained containing as much as 30 per cent. of oxide of manganese. This residue is of a deep black colour, and is exceedingly plastic. The oxide of manganese I believe to have been derived from the Reading Beds, and an inspection of Section 8, taken at Bernard's Heath, St. Albans, will show the material, *b*, caught, as it were, in the act of being incorporated with the gravels, B, by the action of the water from which the beds were deposited.

Another interesting feature about the beds of gravel and sand is the internal evidence they present that there are, at least, two distinct deposits of gravel, of different characters, and probably of different ages. An ideal section of the gravel and sands would be like that in Section 9, showing a lower and an upper bed of gravel and sand, separated by a thinner bed of loam. Such an appearance as the section represents can be made out in most of the gravel-pits or cuttings in Western Hertfordshire, and the upper gravel can be distinguished from the lower gravel by paying attention to the mineral composition of both deposits.

Section 9.—Ideal Section of Glacial Drift.

A. Soil.

B. Upper bed of gravel with numerous small flints and flint pebbles.

C. Middle bed of loam [sometimes sand].

D. Lower bed of gravel with large flints, pebbles of quartzite, quartz, and flint, and blocks of greywether sandstone, Hertfordshire pudding-stone, etc.

The lower gravel, generally speaking, contains all, or nearly all, the large quartzite-pebbles, quartz-pebbles, unworn flints, and blocks of pudding-stone and greywether sandstone, while the upper gravel is usually more flinty, and there are comparatively few quartzite-pebbles, which are usually not more than one inch long. Both upper and lower gravels contain a large number of grains of quartz of a special kind. These grains are usually about a twentieth of an inch in diameter and are well rounded, but with this peculiarity, that each grain presents several rounded protuberances, as may be seen by examining a little of the gravel-matrix by means of a lens.

It is almost unnecessary to state that the quartzites, quartz, felspar-porphyry, etc., have been transported from a distance, but it is difficult to decide from what localities. A section of quartzite cut from a specimen taken from a Watford gravel-pit appeared, when examined under the microscope, to be very similar to specimens found in the New Red Sandstone of the Midlands.

Boulder-Clay.

The clay at Bricket Wood is believed to have been produced by the action of ice, most probably land-ice, which ground down the subjacent rocks into a fine powder, or rock "flour," and left this behind as a clayey deposit.

The boulder-clay rests on a deposit of gravel and sand, similar to those described above, and reaches a thickness of about 40 feet. It contains flints, flint-pebbles, Jurassic and other fossils, chalk, septaria, quartzites, and grits. Most of these materials are believed to have been transported from distant deposits by the moving ice. When fresh the boulder-clay is of a bluish colour, but when weathered it becomes brown. It is very plastic, but remarkably tough when fairly dry, so tough, in fact, as to be very difficult and expensive to excavate.

Gravelly Clay.

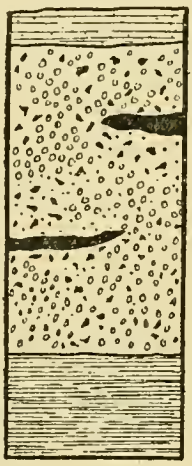
In the extreme north-western part of the County, near Marston Gate, there is a thin deposit of gravelly clay lying above the Gault. About two-thirds of an average sample consisted of dark-coloured clay, apparently derived from the denudation of the Gault, and the remainder mainly of dark red, light red, brown, and grey quartzites, fine-grained breccias, coarse grits, flints, and quartz-pebbles. The quartzites, and some of the other rocks found in the clay, are similar to some of those found in the gravels in the southern part of the County.

Chalk-Pebble Gravel.

The last deposit which will be described is that which is shown on the map near Long Marston as chalk-pebble gravel. It is thin, and is remarkable for containing an exceedingly large number of chalk-pebbles of all sizes, from that of a pin's head up to an inch in diameter. These pebbles, which are often hard, form about half the deposit, the other half being made up of unworn and subangular flints, isolated masses of Greensand, and a little oxide of manganese. The gravel is worked for road-metal, for which it is suitable, after being coarse-sieved and then weathered. Section 10 shows the bed exposed south of Gubblecote. There can be little doubt about the formation of these chalk-pebbles by the action of water, and it is probable that they are the remnants of a shore-deposit which was formed by a sea, or an arm of the sea, which

once washed the upper parts of the Chiltern Hills. This, however, like so many geological questions of a similar nature, is largely a matter for conjecture.

Section 10.—Near Gubblecote.



A. Soil.

b. Manganese deposits.

C. Chalk pebble-gravel.

D. Gault.

This completes the account of the gravels, sands, clays, and loams of Western Hertfordshire, so far as they were intended to be treated in this paper. The account itself is incomplete in many respects, and many interesting parts of the subject have not been discussed. I trust, however, that I have succeeded in describing the beds correctly, and that I may be excused from discussing the subject from a speculative point of view.

XXI.

ANNIVERSARY ADDRESS.

By the President, the Right Honourable the Earl of Verulam.

Delivered at Watford, 20th March, 1900.

Ladies and Gentlemen,—

It is the unenviable lot of the President of the Hertfordshire Natural History Society to have to give an address to the Members of that Body at the termination of each of his years of office. And if, as in my case, he is of a modest disposition, and has never committed such a crime before, he will naturally approach his task with much trepidation, which he may hope his audience will understand and for which it will make generous allowance.

With regard to the choice of a subject, it may be at once said that unless one has followed up a special line of research with some assiduity, one is scarcely justified in presenting what would be little more than a *réchauffé* of the labours of some of the Pioneers of Science; and therefore I propose to-night not to go deeply into any special matters, but to offer a few reflections upon some of the phenomena which exist in our own immediate neighbourhood, in the hope that, if not very profound or scientific, they may still be considered of interest as an illustration of the conditions which once prevailed in this portion of the globe. Probably every person whom I am now addressing is perfectly well aware that there exists beneath our feet a natural phenomenon about which they have not, I imagine, given themselves much trouble to think, but which, to the careful student of nature, presents a history as amazing as any in the remarkable series of marvels which geology can unfold. I refer to the immense layer of chalk which exists over so important a portion of our Island, and which I think I may safely say is to be found at varying depths beneath the whole of the top soil of Hertfordshire, except in the extreme north and west.

A casual observer will, in all probability, scarcely give a thought to this marvel of Nature: he will be content, perhaps, with wondering if lime can be made of it; or, if a farmer, may speculate as to its value as a fertilizer to his crops; while the sentimentalist will, maybe, admire its scenic beauty in the white cliffs of Dover, and, ignorant of its wonderful history, hardly spare it a second thought.

But when it is considered, as science has proved, both by visible evidence and closely-reasoned argument, that this immense bed of material was formed out of deep-sea mud, and that this mud was created by, or more properly speaking, out of the bodies of creatures whose average diameter when living was from one-hundredth to one-seven-thousandth of an inch, the field of imagination grows at once to dimensions which it will be impossible to adequately cover in the course of my short address of this evening.

As an illustration, which, though actually not so wonderful, seems somehow to be more so, because one's mind can grasp it more readily, I may mention that a few years ago, when travelling near the Puy de Dôme in the Auvergne, where there are large limestone hills (we should call them mountains in this country), my attention was called to the fact that these limestone hills were practically composed of the fossilized bodies of dead mayflies or their caddis-worms, which had been replaced, as the bodies decayed, by exact reproductions, or, as one might describe them, "casts," in limestone, of the perfect insects, the shapes of which could, without very much difficulty, be exhibited by breaking the lime stone with a steady hand.

Scattered throughout the Chalk, also, are found various larger fossils.

At Sopwell, about a mile and a quarter from St. Albans, in the process of digging for gravel, another curious formation has been exposed. Firstly, we find a layer of gravel of varying thickness, say 12 to 20 feet, and below this there lies a deep bed of sand, perhaps 20 feet more, though, as we then reach water, we do not know the full depth of this deposit.

Between the sand and the gravel are occasionally found fossil marine animals, such as sea-urchins, also a kind of bivalve shell resembling to some extent an oyster shell, etc., and some of these shells are found imbedded in the centres of flints which apparently have formed round them after the death and fossilization of the creature. In most cases these fossils, though not much worn, have evidently been rolled about to a considerable extent in their fossil state, which would apparently indicate that they were exposed to the action of the sea for some time before being covered over by the bed of gravel.

This deposit of sand is found, in varying thickness, over a very wide area in our County, and frequently at considerable depth. At Sopwell it is regularly stratified, and the strata show a certain inclination or "dip," which leads one to the conclusion that the

sand was formed by the action of the sea on its present site, and was not brought from a far distance by glacial action or the waters of a torrent, as may have been the case with the superincumbent gravel.

Below these comes the Chalk. It is known to exist in places to a depth of over 1,000 feet, and Huxley has shown that its deposit could hardly have been at a more rapid rate than an inch in a year, and probably that the rate was very much slower; consequently, and without taking into account the question of the strata which exist below, we arrive at the conclusion that the Chalk formation, at the lowest estimate, could not have taken less than 12,000 years to create, and all this must have taken place while Hertfordshire was underneath a deep sea.

Then we have to account for the thick bed of sand to which I have referred. It is very difficult to discover a satisfactory theory as to how so widespread an area could have been so regularly covered with such a persistent layer as this undoubtedly is. I can only surmise that the retreat of the sea must have been very gradual, to afford the waves sufficient time to roll and grind the pebbles of the shore, over so large a district, into sand. He would be a bold man who ventured to estimate the length of time that this operation would consume.

Then when the sea had retired, I imagine that some fresh-water flood brought down and deposited (whether through the agency of ice, or how, I cannot say), the gravel, and left it on the top of the sand, thus completing the story of this curious formation.

It is frequently said by the thoughtless that science is incompatible with religion, and that by proving the date of the world's birth to be anterior to the modern estimate of that of Adam, we are disproving the truth of Holy Writ; but I am satisfied that this is an unfounded apprehension, as a little intelligent study of the Bible itself, instead of other people's ideas of what is in it, will show.

I have been asked to draw your attention to the recent establishment, in St. Albans, as a fairly central situation in Hertfordshire, of the County Museum, and to express the hope that it will be adequately supported from all parts of the County, both by practical help and by those who possess articles of local interest and value either offering them to the Museum directly as gifts or as loan collections.

The word "museum," as you know, is derived from the Greek *μουσεῖον*, signifying a collection of natural, scientific, or other curiosities, or of works of art.

A provincial museum such as ours should not, in my opinion, aim at quite the same object as the National Institution of which we are all so proud, and indeed it is practically out of the question for a nation to have more than one such treasure-house, if any approach to perfection is to be sought.

A local museum should be maintained for the preservation of objects of local interest and for the encouragement of study, which, without the illustration which its contents afford, would often be colourless and devoid of reality. There should also be a few reproductions or models of some of the best and most beautiful works of art, to guide and form the taste of those who perhaps have little or no opportunity of seeing the originals; but these should be limited in number and should not be allowed to divert the storage room of the museum from its local duties, which are the most important, as within its walls can be collected a much wider and more detailed series of articles of local interest than could possibly find space in a national museum, which has its gathering-ground not only in all parts of the nation but also of the entire world.

I have to express my sincere thanks for the kind forbearance with which you have listened to my feeble effort, and I trust that I have not wearied you too much.

XXII.

THE HABITATS OF THE MYCETOZOA.

By James Saunders, A.L.S., and E. Saunders.

Read at Watford, 10th April, 1900.

The study of the Mycetozoa has received a marked stimulus in this country during the last few years, chiefly through the writings and efforts of such enthusiasts as Mr. Arthur Lister, the Right Hon. Sir Edward Fry, Mr. George Massee, and others.

Consequent upon this the literature of the subject has lately been considerably increased, but nowhere have we met with any article which treats of these organisms from the standpoint in which they are regarded in the present communication.

In all catalogues and monographs of the Mycetozoa, it is customary to mention the kind of vegetation on which they are found, but nowhere, to our knowledge, are they grouped according to habitat. It is almost superfluous to state that these creatures are saprophytes. They are denizens of masses of decaying vegetation, and frequent such situations as dead leaf-heaps, rotten branches in damp woods, tree-stumps, old straw-heaps, and, much more rarely, Sphagnum and humus. In the last mentioned, *Spumaria alba*, D.C., sometimes finds a congenial home. Although Mycetozoa are sometimes found on living plants, in such cases they have crept up from underlying decayed vegetation. A remarkable exception is that of the plasmodium of *Badhamia reticularis*, which often flourishes on living woody fungi, such as *Stereum* and *Irpex*.

Until the spring of 1897 the researches of British observers were almost entirely limited to rotten wood and decayed leaves, but from that period till now considerable attention has been paid to the possibilities of straw-heaps, especially those which have lain undisturbed for several months. The results have been most gratifying to those who have pursued these investigations. In proof thereof it is sufficient to say that from April, 1897, till the date of writing (October, 1899), this field of research has yielded the previously undescribed species, *Physarum straminipes*, List., and *Didymium Trochus*, List.; and the first known British records of *Physarum didermoides*, Rost., variety *lividum* (var. nov.), Lister (see 'Journ. Bot.,' vol. xxxvi, p. 161), of *Badhamia ovispora*, Racib., and of *Fuligo ellipsospora*, List.

Extended and frequent observations of the denizens of straw heaps suggest another peculiarity in the occurrence of the Mycetozoa, which is that certain species affect different strata of the accumulated material. In illustration or confirmation of this suggestion the following data are advanced:—

Species usually found at or near the surface:—*Physarum calidris*, List., *P. didermoides*, Rost., and its var. *lividum*, List., *Fuligo septica*, Gmel., *Didymium nigripes*, Fr., *Spumaria alba*, D.C.

Species usually found at or above the line of saturation:—*Badhamia ovispora*, Racib., *Physarum compressum*, Alb. & Schw.,

P. straminipes, List., *P. Crateriachea*, List., *Craterium pedunculatum*, Trent., *C. leucocephalum*, Ditm., *C. mutabile*, Fr., *Chondrioderma spumaroides*, Rost., *C. Michelii*, Rost., *Perichæna variabilis*, Rost.

Species usually found at or below the line of saturation :— *Didymium difforme*, Duby, and *D. Trochus*, List.

In regard to *D. Trochus*, List., it is remarkable that it rarely fruits in any other situation than where the material is saturated with moisture. We have had under observation during the last three seasons many thousands of the sporangia of this species, and it is most rare to find any of them near the surface, or in such situations as would favour the dispersal of the spores. They are usually so charged with moisture that it is expedient to raise the lower layers of straw, and spread them out to the wind, when the sporangia rapidly dry and are thus rendered conspicuous. Notwithstanding these apparent obstacles to the distribution of the spores, recent observations prove that this species is of frequent occurrence in the South Midlands over an area of eight miles square. It has also been observed near Reigate by Mr. E. S. Salmon.

The following list represents what has been noticed as to the habitats of the Mycetozoa in numerous localities in the South of England. The observations have ranged from Merioneth to Norfolk, and from North Devon to Kent, but the largest proportion of them are from the counties of Beds, Herts, and Bucks. The few entries that are not original are based upon specimens which have been kindly forwarded to us by Mr. A. Lister, Mr. C. Crouch, and Mr. George Massee.

The term *Wood* includes rotten branches, trunks, and tree stumps ; *Straw* includes the refuse and haulms of cereals, peas, beans, and the agrarian weeds associated with them ; *Leaves* include the twigs of wood usually found associated with them.

	Wood.	Straw.	Leaves.		Wood.	Straw.	Leaves.
Ceratiomyxa mucida, *Schroeter*	x			Physarum viride, *Pers.*	x		
Badhamia hyalina. *Berk.*	x			P. nutans, *Pers.*	x		
B. utricularis, *Berk.*...	x			,, *var.* leucophæum	x	x	x
B. follicola, *Lister* ...			x	P. calidris, *Lister*.....		x	x
B. nitens, *Berk.*	x			P. compressum, *Alb.* & *Schw*.....	x	x	
B. macrocarpa, *Rost.*	x			P. straminipes, *Lister.*		x	
B. panicea, *Rost.*	x			P. didermoides. *Rost.* .	x	x	x
B. ovispora, *Raeib.* ...		x		,, *var.* lividum, *Lister* ...		x	
B. lilacina, *Rost.*			x	P. Crateriachea, *Lister*		x	
B. rubiginosa, *Rost.* ...			x	P. cinereum, *Pers.* ...		x	x
Physarum leucopus, *Link*	x		x	P. bivalve, *Pers.*	x	x	x
P. murinum, *Lister*....	x			P. Diderma, *R st*.....	x		x
P. citrinum, *Schum*....	x			P. contextum, *Pers.* ...	x		x
P. psittacinum, *Ditm*..	x			P. conglomeratum, *Rost.*	x		x

	Wood.	Straw.	Leaves.		Wood.	Straw.	Leaves.
Physarum vernum, *Somm.*		x	x	Lindbladia Tubulina, *Fries.*	x		
Fuligo septica, *Gmel.*	x	x		Cribraria argillacea, *Pers.*	x		
F. ellipsospora, *Lister*		x	x	C. aurantiaca, *Schrad.*	x		
Craterium pedunculatum, *Trent.*	x	x	x	C. violacea, *Rex.*	x		
C. leucocephalum, *Ditm*		x	x	Dictydium umbilicatum, *Schrad*	x		
C. mutabile, *Fr.*		x	x	Licea flexuosa *Pers.*	x		
Leocarpus vernicosus, *Link*	x		x	Tubulina fragiformis, *Pers.*	x		
Chondrioderma spumarioides, *Rost.*		x	x	Dictydiæthalium plumbeum, *Rost.*	x		
C. testaceum, *Rost.*	x		x	Enteridium olivaceum, *Ehrenb.*	x		
C. Michelii, *Rost.*	x	x	x	Reticularia Lycoperdon, *Bull.*	x		
C. reticulatum, *Rost.*			x	Trichia affinis, *De Bary*	x		
C. niveum, *Rost.*			x	T. persimilis, *Karst.* (= T. Jackii, *Rost.*)	x		
C. radiatum, *Rost.*	x			T. scabra, *Rost.*	x		
Diachæa elegans, *Fries.*	x		x	T. varia, *Pers.*	x		
D. subsessilis, *Peck*	x		x	T. contorta, *Rost.*	x		
Didymium difforme, *Duby.*	x	x	x	T. fallax, *Pers.*	x		
D. Trochus, *Lister*		x		T. Botrytis, *Pers.*	x		x
D. dubium, *Rost.*			x	Oligonema nitens, *Rost.*	x		
D. Serpula, *Fr.*	x		x	Hemitrichia rubiformis, *Lister*	x		
D. Clavus, *Rost.*	x		x	H. clavata, *Rost.*	x		
D. farinaceum, *Schrad.*	x		x	Arcyria ferruginea, *Sauter*	x		
D. nigripes, *Fr.*		x	x	A. albida, *Pers.*	x	x	
D. effusum, *Link*	x	x	x	,, *var.* pomiformis	x		
Spumaria alba, *D.C.*		x	x	A. puuicea, *Pers.*	x		
Lepidoderma tigrinum, *Rost.*	x			A. incarnata, *Pers.*	x		
Stemonitis fusca, *Roth.*	x			A. flava, *Pers.*	x		
,, *var.* confluens.	x			Perichæna depressa, *Libert*	x		
S. splendens, *Roth*	x			P. populina, *Fries.*	x		
S. ferruginea, *Ehrenb.*	x			P. variabilis, *Rost.*	x	x	x
S. Smithii, *Macbr.*	x			Margarita metallica, *Lister*	x	x	
Comatricha obtusata, *Preuss*	x	x		Dianema Harveyi, *Rex.*	x		
C. laxa, *Rost.*	x			D. depressum, *Lister.*	x		
C. typhoides, *Rost.*	x			Prototrichia flagellifera, *Rost.*	x	x	
C. Persoonii, *Rost.*			x	Lycogala flavo-fuscum, *Rost.*	x		
C. rubens. *Lister*		x	x	L. miniatum, *Pers.*	x		
Enerthenema elegans, *Bowm.*	x						
Lamproderma physaroides, *Rost.*	x						
L. arcyrionema, *Rost.*	x						
L. irideum, *Mass.*		x	x				
L. violaceum, *Rost.*	x						
Brefeldia maxima. *Rost.*	x						

It is hoped that this list is sufficiently varied and extensive to warrant us in bringing the matter under the notice of those who are interested in the Mycetozoa.

It will be seen that some genera have been observed only on wood, but these again could be further grouped as to whether they affect oak (*Badhamia nitens*, Berk.), elm and beech (*Lycogala flavo-fuscum*, Rost.), or Coniferæ and chestnut (*Cribraria aurantiaca*, Schrad.).

Other species are apparently limited to straw-heaps, such as *Badhamia ovispora*, Racib., and *Physarum straminipes*, List.

Some few species seem indifferent to their environment, of which one may specify *Didymium effusum*, Link, and *D. difforme*, Duby.

Of the genus *Trichia* and its allies, *Hemitrichia* and *Oligonema*, some species of which are very abundant, none have been found by us to have inhabited any other substance than decayed wood. If they are attached in the fruiting-stage to living moss which may be growing on rotten stumps and branches, it is simply that they have crept up to these positions to form their sporangia, so that the spores may be more easily distributed. The only exception is that of a small gathering recently obtained from a straw heap at Chaul End, which exhibits characters intermediate between those of *Trichia* and *Perichæna*. Its exact position is not yet determined, and it will be expedient to await its rediscovery before pronouncing definitely upon it. Sphagnum may be credited with two species in Great Britain ; these are *Badhamia lilacina*, Rost., Pilmoor, Yorks (Miss G. Lister), and Flitwick, Beds ; *Chondrioderma simplex*, Schroeter, Perthshire (Miss G. Lister), and Merionethshire.

The foregoing observations have reference only to what is known to us of the habitats of the Mycetozoa in Great Britain. It will be readily understood that in foreign countries vegetable refuse would consist of the remains of such plants as are natives of these countries or are cultivated in them.

XXIII.

REPORT ON PHENOLOGICAL PHENOMENA OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1899.

By Edward Mawley, Sec. R. Met. Soc., F.R.H.S.

Read at Watford, 10th April, 1900.

The only change in the list of observing stations since the last report was issued has been the addition of a new station at Wealdstone close to the southern limits of the county, so that the observers remain as evenly distributed over Hertfordshire as before. In fact, the only part of the county altogether unrepresented is the neighbourhood of Buntingford.

The following table gives the list of observers, the districts they represent, and the approximate height of the stations above sea-level:—

Station.	Height above Sea-level.	Observer.
Wealdstone	180 feet.	G. E. Eland.
Watford (The Platts)	240 ,,	Mrs. G. E. Bishop.
Chesham (Cannon Mill Cottage)	300 ,,	Miss G. Keating.
Broxbourne	120 ,,	Rev. H. P. Waller.
St. Albans (The Grange)	380 ,,	Mrs. J. Hopkinson.
Berkhamsted (Rosebank)	400 ,,	Mrs. E. Mawley.
Hatfield (Symonds Hyde)	300 ,,	T. Brown.
Hertford	140 ,,	W. Graveson.
Sawbridgeworth	240 ,,	H. S. Rivers.
Harpenden (Hecla Villa)	370 ,,	J. J. Willis.
Hitchin	230 ,,	A. W. Dawson, M.A.
Ashwell (Odsey)	260 ,,	H. G. Fordham.

The Winter of 1898–99.

The weather of this winter was chiefly remarkable for its continued high temperature and the unusually good record of bright sunshine, the average duration being about 2¼ hours a day. Considering the season, the number of frosty nights was small, and at no time did the thermometer exposed on the lawn register more than 18 degrees of frost. There were rather more than the usual number of rainy days, but the total rainfall was not much in excess of the average. The sun shone at Berkhamsted for altogether 201 hours, or for a longer time than in any other winter during the 15 years over which my sunshine-records extend.

Notwithstanding the frequent falls of rain, all the seasonable operations on the farm were carried out with but little hindrance from the weather. This was no doubt owing to the subsoil having become so extremely dry through the preceding summer and early autumn drought, that all superfluous moisture in the surface-soil

TABLE I.—DATES OF FLOWERING OF PLANTS OBSERVED IN 1899, WITH THE MEAN DATE FOR 1876–1898.

SPECIES.	WEALD-STONE.	WAT-FORD.	CHES-HAM.	BROX-BOURNE.	ST. ALBANS.	BERK-HAMSTED.	HAT-FIELD.	HERT-FORD.	SAW-BRIDGE-WORTH.	HAR-PENDEN.	HITCHIN.	ASHWELL (Odsey).	MEAN, 1876–98.
Hazel (*Corylus avellana*)	Feb. 25	Jan. 28	Jan. 28	Feb. 26	Jan. 16	Feb. 14	Jan. 24	Jan. 29	.....	.....	.....	Jan. 20	Jan. 29
Coltsfoot (*Tussilago farfara*)	.....	.....	Feb. 10	Apl. 12	Mar. 1	Mar. 6	.....	Feb. 19	Feb. 23	.....	Mar. 7	.....	Feb. 26
Wood-Anemone (*Anemone nemorosa*)	Apl. 30	Apl. 26	Mar. 29	Apl. 2	Apl. 4	Apl. 10	.....	Mar. 19	.....	Apl. 25	.....	.....	Mar. 20
Blackthorn (*Prunus spinosa*)	Apl. 8	Apl. 5	Apl. 2	Apl. 2	Apl. 5	Apl. 2	.....	Mar. 12	Apl. 3	Apl. 10	.....	Apl. 8	Apl. 2
Garlic Hedge-Mustard (*Alliaria officinalis*)	.....	Apl. 22	Apl. 27	Apl. 21	Apl. 21	Apl. 28	.....	Apl. 16	Apl. 8	Apl. 30	Apl. 26	.....	Apl. 20
Horse-Chestnut (*Æsculus hippocastanum*)	May 14	May 15	May 13	May 16	May 17	May 14	May 10	.....	May 15	.....	May 15	.....	May 9
Hawthorn (*Cratægus oxyacantha*)	May 13	May 18	Apl. 23	May 14	May 15	May 29	May 9	May 11	.....	May 22	May 11	May 19	May 12
White Ox-Eye (*Leucanthemum vulgare*)	.....	June 2	May 25	.....	May 10	May 25	June 6	May 23	.....	.....	May 27	.....	May 20
Dog-Rose (*Rosa canina*)	.....	June 10	.....	.....	June 10	June 6	June 8	June 4	June 5	.....	.....	June 7	June 5
Black Knapweed (*Centaurea nigra*)	.....	.....	July 21	.....	July 11	June 25	.....	June 27	.....	.....	.....	.....	June 22
Harebell (*Campanula rotundifolia*)	July 5	.....	.....	.....	July 7	July 12	.....	July 14	.....	.....	.....	.....	July 5
Greater Bindweed (*Convolvulus sepium*)	.....	.....	July 11	.....	July 20	July 9	.....	July 10	July 15	.....	July 23	.....	July 9
Ivy (*Hedera helix*)	.....	Sept. 28	.....	Sept. 10	Sept. 21	Sept. 23	.....	Sept. 18	.....	.....	Sept. 22	.....	Sept. 27

TABLE II.—EARLIEST DATES OF OBSERVATION OF BIRDS AND INSECTS IN 1899, WITH THE MEAN DATE FOR 1876–1898.

SPECIES.	WEALD-STONE.	WAT-FORD.	CHES-HAM.	BROX-BOURNE.	ST. ALBANS.	BERK-HAMSTED.	HAT-FIELD.	SAW-BRIDGE-WORTH.	HAR-PENDEN.	HITCHIN.	ASHWELL (Odsey).	MEAN, 1876-98.
BIRDS.												
Song-Thrush (*Turdus musicus*)	.....	Jan. 8	Jan. 27	.....	.....	Jan. 14	Jan. 19	Jan. 9	.....	Jan. 15	.....	Jan. 17
Swallow (*Hirundo rustica*)	Apl. 23	Apl. 27	Apl. 20	Apl. 16	Apl. 18	Apl. 17	Apl. 29	Apl. 18	Apl. 18	.....	Apl. 20	Apl. 12
Cuckoo (*Cuculus canorus*)	Apl. 22	Apl. 19	Apl. 20	Apl. 14	Apl. 17	Apl. 12	Apl. 16	Apl. 17	Apl. 20	Apl. 25	Apl. 26	Apl. 13
Nightingale (*Daulias luscinia*)	Apl. 30	May 1	May 5	Apl. 19	Apl. 22	Apl. 17	Apl. 20	Apl. 20	Apl. 23	Apl. 19	Apl. 19	Apl. 15
Spotted Flycatcher (*Muscicapa grisola*)	.....	May 25	.....	May 29	.....	.....	.....	May 12	.....	May 3	May 19	.....
Swallow (last seen) (*Hirundo rustica*)	Oct. 8	Oct. 2	Oct. 9	.....	.....	Oct. 12	.....	Oct. 5	.....	Oct. 12	Oct. 10	.....
INSECTS.												
Honey-Bee (*Apis mellifica*)	.....	.....	(Apl. 30)	.....	Feb. 23	Feb. 10	.....	Feb. 17	.....	.....	Feb. 16	Jan. 29
Wasp (*Vespa vulgaris*)	.....	Mar. 24	May 4	Apl. 3	.....	Mar. 11	.....	(Feb. 10)	.....	.....	.....	Apl. 5
Small White Butterfly (*Pieris rapæ*)	.....	(May 5)	Mar. 13	Apl. 19	Apl. 9	Mar. 17	.....	Mar. 13	Apl. 19	.....	.....	Apl. 4
Orange-Tip Butterfly (*Anthocaris cardamines*)	.....	.....	May 7	May 21	May 26	.....	..	May 20	.....	.....	.....	May 7
Meadow-Brown Butterfly (*Epinephile janira*)	.....	.....	May 6	.....	.....	.....	.....	(July 9)	.....	May 7	.....	May 20

became rapidly absorbed, and the ground was soon in as good a working condition as before. The longest interruption took place in February, by which time the ground had become saturated to some depth, when the frequent and heavy rains of the early part of that month for a time stopped all further progress. The autumn-sown cereals, owing to the general warmth of the soil and the exceptionally sunny character of the winter, made steady and at the same time sturdy growth. Another great advantage to the farmer in this open season, considering how short had been the yield of roots in the previous autumn, was the way in which the grass in the pastures continued fresh and green throughout the whole winter.

In the gardens the mild season allowed many flowering plants to continue much later in bloom than usual. Our Chesham observer, for instance, noted that the large-flowered periwinkle remained in blossom well into the new year. The last rose-bloom of the season was destroyed by frost in my garden on the last night but one of 1898, that is to say, twenty-four days later than the average date of its destruction in the previous thirteen years, and later than in any of those years except 1885 and 1894. The winter aconite came into flower in the same garden on the 18th of January, which is four days earlier than its average date of first flowering in the previous ten years. The warm winter also greatly favoured the winter supply of green vegetables.

The drought of the previous year had penetrated the ground to such an unusual depth that it was only after the best transplanting month, November, was over that deep-rooting fruit and other trees could be taken up and with safety planted in their new quarters.

According to the returns received from the observers, the hazel first showed its fertile flowers, taking the county as a whole, five days later than its average date in the previous twenty-three years; while the coltsfoot was six days late.

The song-thrush was first heard to sing after the new year two days earlier than usual, whereas the honey-bee made its appearance among flowers nineteen days behind its usual time.

The Spring.

This was rather a cold spring, and on one night in March the exposed thermometer showed 22 degrees of frost. March was a singularly dry month, but the rainfall for April and May taken together was in excess of the mean. The sun shone during the quarter on an average for five hours a day, which is slightly in excess of the average for the season.

Throughout March the soil remained in splendid condition for working, and considerable progress was made in spring-sowing, but the weather afterwards continued for a time so persistently wet that the further cultivation of the land was frequently interrupted. Owing to the generally low temperature and cold winds the corn and grass made but slow, although on the whole satisfactory, growth.

The frequent moderate frosts which occurred at the end of May, when many apple and other fruit trees were in full blossom, did considerable damage. For my own part I cannot but think that the dry condition of the subsoil in the previous summer, by lowering the vitality of the trees themselves, must also to a great extent be held answerable for the way in which the fruit blossom fell on this occasion such an easy victim to these moderate frosts.

As might have been expected, wild plants were as a rule late in coming into flower. For instance, the wood-anemone was twenty-one days late, the blackthorn three days late, the garlic hedge-mustard two days late, the horse-chestnut five days late, the hawthorn two days late, and the white ox-eye six days late.

The spring migrants made their appearance somewhat behind their usual time, the swallow being as much as nine days late, the cuckoo six days late, and the nightingale eight days late.

The wasp first appeared thirteen days late, the small white butterfly four days early, the orange-tip butterfly twelve days late, and the meadow-brown butterfly thirteen days early.

The Summer.

This was a singularly hot summer. Indeed, on no fewer than twenty-two days the temperature in shade rose to or exceeded 80 degrees. The rainfall was very light, and there was an unusually small number of rainy days. The sun shone on an average for nearly eight hours a day, or for a longer period than in any summer during the fifteen years covered by my sunshine-records at Berkhamsted.

Favoured by the dry and sunny weather, the hay harvest was carried out with expedition and under the best possible conditions. Unfortunately the absence of rain in the early part of June, and the low temperature at the end of May, had so checked the growth of the grass at this critical period that the hay-crop proved an unusually scanty one. The light rainfall did not appear to seriously affect the cereals, except in so far that they were all much shorter in the straw than usual. Turnips, however, suffered severely, and in many localities, owing to the attacks of "fly," it was difficult to obtain any yield at all. In fact, there has seldom been a season which has proved from beginning to end so disastrous to the growth of this particular crop. The corn, favoured by the forcing weather, ripened rapidly. As had been the case with the hay, the ingathering of the cereals took place in the most favourable weather, and consequently with a minimum amount of trouble. The growth of the grass in the meadows and pastures when once the drought had set in was soon brought to a standstill, so that during a great part of the season there was little feed for the sheep and cattle in the fields.

If a trying season to the turnips and grass on the farms, it was also an equally trying one in the vegetable and flower garden. In fact, as the summer advanced it was only by constant hoeing and watering, or by the application of an efficient mulching, that

many moisture-loving plants and shrubs could be kept alive. It was not only the heat combined with the dry condition of the soil that rendered this summer so trying to vegetation, but likewise the harsh and dry nature of the air. To give some idea as to the character of this summer drought, I may mention that between the middle of July and the middle of August no rain-water at all came through the two and a half feet of soil in either of my uncropped percolation-gauges.

There was a singular absence of greenfly. Indeed, seldom have I known a spring and summer in which my roses have been less troubled by this annual pest. On the other hand, both the large and small white butterflies were unusually numerous.

The following are a few extracts from the observers' notes. Haymaking began at Wealdstone on June 10th. At Harpenden the first wheat-ear was out of its sheath on June 12th, or four days later than its average date in the previous seven years. At Wealdstone oats were first cut on July 22nd. At Watford apples and medlars were dropping from the trees in August, owing to the drought, while the pastures and lawns were brown and dried up. From Hatfield it is reported that the oaks had been during the summer almost entirely free from caterpillars, and that this was the first time for several years that the foliage has not been, to a great extent, destroyed by them. The apple crop is stated to have been there a complete failure, whereas for the previous seven years at least the yield of this fruit had been invariably good. Our observer at Hitchin, referring to the drought, says that the spring at Wellhead, the source of the Hiz, about a mile south-west of Hitchin, was dry for some months in the summer, as was also the case in 1898. This, he adds, so far as he can ascertain, has not occurred before within living memory.

It is rather surprising, when we consider what a warm season this was, that each of the four summer flowering plants on the list should have been behind its average date in coming into blossom, and yet such was the case; the dog-rose being two days late, the black knapweed fourteen days late, the harebell five days late, and the greater bindweed six days late.

The Autumn.

Taken as a whole this was another warm season, but the weather as regards temperature varied greatly. For instance, during the first three weeks in October there occurred but one unseasonably warm night, whereas in November there were scarcely any cold days or nights. In the same way the dry and wet periods were very unequally distributed over the quarter, while the total rainfall was about the average. The mean daily duration of sunshine amounted to $3\frac{3}{4}$ hours a day, which is an unusually good record for the season.

So early did the harvest begin, and so soon was it over, that little corn was to be seen in the fields, except perhaps in the colder districts, when the autumn was entered upon. In most

localities the wet weather which set in at the end of October came too late to save the turnips, but in those parts of the county where the drought was least severe they considerably improved. The mangolds almost everywhere withstood the dry weather far better than the swedes and turnips. These late rains, coming as they did when the ground was still unusually warm for the time of year, had a magical effect upon the pastures, which rapidly recovered, and in a short time presented a greener appearance than they had done for months. According to the returns sent in to the 'Agricultural Gazette,' the yield of the principal farm-crops in the county generally was as follows: Wheat about average, barley and oats under average, beans and peas under average, turnips and hay much under average, while the crops of mangolds and potatoes were about the average.

The rains referred to were equally welcomed by the gardener, for the vegetables had made such poor growth during the summer that a warm and wet period was required to enable them to regain some of the ground they had lost before the winter set in. In fact, there were few plants, whether in the flower or kitchen garden, which were not greatly benefited. In those localities which escaped the early autumn frosts the blossoming period of the dahlias and other autumn flowers lasted throughout the season. At Berkhamsted the upper half of my dahlias was blackened as early as the 29th of September, and their prospects of flowering ruined for the rest of the year. The plants, however, lingered on in this crippled condition until November 18th, when the frost of the preceding night cut them to the ground. This is a fortnight later than the average date of their destruction in the previous fourteen years.

Taking the county as a whole, the yield of apples, pears, and plums was poor, while all the smaller fruits were about average crops. These particulars I have obtained from returns sent in to the 'Gardeners' Chronicle' in August last.

The last swallow was thirteen days late in taking its departure as compared with its average date for the previous eight years.

XXIV.

NOTES ON BIRDS OBSERVED IN HERTFORDSHIRE DURING THE YEAR 1899.

By Alan F. Crossman, F.L.S., F.Z.S., M.B.O.U.

Read at Watford, 10th April, 1900.

I regret that I must complain about the scarcity of notes sent to me for my paper this last year: whether it is that my correspondents are becoming fewer in number, or whether they think that I only care for the records of the rarer species, I do not know, but I hope that the latter reason is the true one, as that is more easily remedied. Let me at once say that all notes on the birds of this county are most acceptable to me, whether on common or rare species. It is not possible for me to know the distribution of the various birds unless I have information from residents in all parts, for one cannot by occasional visits to a district learn very much about the actual scarcity or otherwise of a species; that can only be learned by long acquaintance with the locality.

Turning now to the actual list of birds, what I have said above must be my apology for its brevity. The majority of my records come from the Tring district; this, no doubt, is due to the reservoirs, which have a great attraction for waders and birds of a water-loving nature.

I will first mention two birds which have been seen in the county, but the records of which are not authenticated as to the actual species. One of these was a yellow and black bird which was seen for some time in the neighbourhood of St. Albans in the summer: from its description it is, I think, referable to the golden oriole (*Oriolus galbula*), but it was not observed by an ornithologist or any person who was acquainted with the species, and it may have been an escaped bird of some other kind. The other bird was seen at Watford on March 26th in Cassiobury Park. It was described to me as being like a robin, with the exception that the breast was blue instead of being red, in addition to which there was a spot in the middle of the blue. This description points very vividly to the bluethroat (*Cyanerula suecica*), but here again the bird, although seen at close quarters, was not positively identified. I have, therefore, not added either of these birds to my list, but have contented myself with mentioning them only in this introduction in the hope that it may be the means of bringing forward more information about them.

I will now proceed to my list of birds, giving such facts as I have obtained about the various species since my last report.

White Wagtail (*Motacilla alba*).—Early in May I was shown in the garden at Cokenach, near Royston, a wagtail's nest containing one egg, and having an opportunity of seeing one of the birds,

I watched it through my field-glasses and found that it belonged to this species. Whether the other bird belonging to the nest was also a white wagtail I had not the opportunity of seeing, but it was interesting to me to find this bird nesting in Hertfordshire. The first record of the white wagtail in our county was in 1895, when it was identified by Mr. H. S. Rivers at Sawbridgeworth, where he afterwards found a nest, one of the occupants of which was undoubtedly of this species.

Goldfinch (*Carduelis elegans*).—In spite of the persecution by birdcatchers of this beautiful bird in many districts, it is, in my opinion, most certainly on the increase in other parts of the county. I very seldom go out in the neighbourhood of Berkhamsted without seeing goldfinches. Mr. M. R. Pryor informs me also that this species was common in the neighbourhood of Stevenage during last winter.

Brambling (*Fringilla montifringilla*).—I saw some of these birds near Berkhamsted as late as April 7th, while a friend of mine saw them in the same district on the 15th of that month.

Lesser Redpoll (*Linota rufescens*).—I have again to record the nesting of this bird in Hertfordshire, as a nest, from which young birds were eventually hatched off, was found in a shrubbery at Newsells, Barkway. This species has only been recorded as nesting in this county on three occasions, although no doubt it would be found much more frequently if diligently searched for.

Crossbill (*Loxia curvirostra*).—This species occurred frequently near Berkhamsted during the early part of 1899, but disappeared entirely during the latter half of the year, nor were any of these birds seen at Tring at that time. I think it possible that they may have nested in Ockridge Wood, near Berkhamsted, as I saw crossbills paired there at the end of February. Mr. E. P. Thompson informs me that he saw a pair in his garden at Elstree on 20th February, 1899.

Short-eared Owl (*Asio accipitrinus*). — This species has not been recorded in Hertfordshire for some years, although in former times it has occurred fairly plentifully. This year I am able to mention a specimen which was obtained at Elstree Reservoir on 12th October, 1899.

Tawny Owl (*Syrnium aluco*).—It is, I should think, somewhat unusual for owls to come to grief by contact with the telegraph-wires, but Mr. H. G. Fordham sent me an example of this species which had met its end in this way.

Buzzard (*Buteo vulgaris*).—This fine species has occurred for at least the last three years at Cokenach, near Royston, during the autumn. Last year one was seen there on October 14th, which is within a week of the date on which a specimen was observed in 1898.

Peregrine Falcon (*Falco peregrinus*).—About the beginning of May in last year a falcon was seen at Cokenach, but it may have been an escaped bird.

Hobby (*Falco subbuteo*).—On July 27th I saw a small falcon at

Crossoaks, Berkhamsted, which, from its flight and appearance, was presumably a hobby, but I was unable to identify it positively on account of the light. It was chasing some house-martins. This beautiful little hawk has now become practically extinct so far as Hertfordshire is concerned, although at one time it was a not uncommon nesting species.

Cormorant (*Phalacrocorax carbo*).—On November 4th Mr. M. R. Pryor, while covert-shooting at Weston Manor, near Stevenage, saw three cormorants fly over, and on December 31st or the following day he observed another pass over within gunshot. The last record I have of this species in Hertfordshire was of one seen at the Tring Reservoirs on 31st October, 1895.

Ringed Plover (*Ægialitis hiaticula*).—This bird, which is an occasional visitor to the Reservoirs, was seen there by Street at various times in 1899.

Grey Plover (*Squatarola helvetica*).—A male, in very good condition, was shot at the Tring Reservoirs by Mr. Hartert on December 12th, while he was duck-shooting. There have been only two previous records of this species in Herts.

Oyster-catcher (*Hæmatopus ostralegus*).—Two oyster-catchers were seen at Elstree Reservoir on 10th April, 1899. The first recorded specimen of this bird in the county was obtained at Elstree in 1866.

Grey Phalarope (*Phalaropus fulicarius*).—Up to 1899 seven birds of this species had been obtained in Hertfordshire. In that year an adult male was picked up dead in December in a wood at Tring Park, called Stubbings. The bird was fresh, but very lean, as if starved.

Dunlin (*Tringa alpina*).—On May 6th I saw a dunlin at Tring in full breeding-plumage, and two were shot by Street at the Reservoirs on September 27th. This small wader occurs there in varying numbers every year.

Redshank (*Totanus calidris*).—This bird occurred at Tring in small parties on three occasions.

Greenshank (*Totanus canescens*).—Although usually seen at Tring frequently during the spring and autumn migration, the greenshank was only once identified by Street in 1899.

Curlew (*Numenius arquatus*).—This bird occurs more frequently at Tring nowadays than formerly, when it was considered quite an unusual visitor. Street saw it there on five occasions, in parties varying from two to nine. It was also identified near Royston on August 7th.

Black Tern (*Hydrochelidon nigra*).—This handsome bird was seen in some numbers at times at Tring in 1899.

Common Tern (*Sterna fluviatilis*).—The common tern occurred at Tring frequently in 1899, at times accompanying the last species.

Little Tern (*Sterna minuta*).—As in former years, small parties of this little bird were seen at the Reservoirs during last year.

Brown-headed Gull (*Larus ridibundus*).—This species was also frequently recognized by Street in 1899.

Common Gull (*Larus canus*). — The common gull occurred at Tring on several occasions during last year, the largest number seen together at one time being six.

Herring-Gull (*Larus argentatus*).—On June 22nd two of these birds were seen at the Reservoirs, while three more were observed there on September 14th.

Lesser Black-backed Gull (*Larus fuscus*).—Street, in his annual report to me, refers to black-backed gulls, in contradistinction to great black-backed gulls, as having occurred on two occasions, and probably means the smaller species.

Great Black-backed Gull (*Larus marinus*).—On May 19th Street saw three birds which he speaks of as great blackbacked gulls, and again on August 2nd he also saw two. I have no doubt that he correctly identified the species on these occasions, as in his letter he differentiates between two kinds of black-backed gulls.

Great Crested Grebe (*Podicipes cristatus*).—I watched a bird of this species which had left her nest and then returned to it, arranging around her with her beak the weeds with which, when she left her nest, she had covered her eggs. It was very interesting to see her do this, as she took each piece separately and placed it on the edge of the nest.

Arrival and Departure of Migrants.

Species.	Locality.	Date.	Observer.
Wheatear (*Saxicola œnanthe*)	Hunton Bridge	Mar. 27	H. Procter.
	Berkhamsted	,, 31	A. F. C.
Whinchat (*Pratincola rubetra*)	Berkhamsted	April 27	A. F. C.
Redstart (*Ruticilla phœnicurus*)	Berkhamsted	,, 26	A. F. C.
Nightingale (*Daulias luscinia*)	Berkhamsted	,, 17	Mrs. E. Mawley.
	Odsey	,, 19	H. G. Fordham.
	Hitchin	,, 19	A. W. Dawson.
	Broxbourne	,, 19	Rev. H. P. Waller.
	Elstree	,, 20	O. E. Dawson.
	Hatfield	,, 20	T. Brown.
	Sawbridgeworth	,, 20	H. S. Rivers.
	St. Albans	,, 22	Mrs. J. Hopkinson.
	Harpenden	,, 23	J. J. Willis.
	Berkhamsted	,, 24	W. B. Hopkins.
	Gallows Hill	,, 27	H. Procter.
Blackcap (*Silvia atricapilla*)	Elstree	Mar. 24	E. P. Thompson.
	Hunton Bridge	April 11	H. Procter.
	Berkhamsted	,, 19	A. F. C.
Chiffchaff (*Phylloscopus rufus*)	Radlett	Mar. 29	H. J. Lubbock.
	Berkhamsted	April 1	A. F. C.
	Hunton Bridge	,, 3	H. Procter.
Willow-Wren (*Phylloscopus trochilus*)	Elstree	,, 1	E. P. Thompson.
	Hunton Bridge	,, 5	H. Procter.
	Berkhamsted	,, 6	A. F. C.
	Radlett	,, 19	H. J. Lubbock.
Grasshopper-Warbler (*Locustella nævia*)	Berkhamsted	,, 22	W. B. Hopkins.
Wood-Wren (*Phylloscopus sibilatrix*)	Berkhamsted	May 3	A. F. C.

Species.	Locality.	Date.	Observer.
Spotted Flycatcher (*Muscicapa grisola*)	Hitchin	,, 3	A. W. Dawson.
	Hunton Bridge	,, 5	H. Procter.
	Sawbridgeworth	,, 12	H. S. Rivers.
	Odsey	,, 19	H. G. Fordham.
Tree-Pipit (*Anthus trivialis*)	Berkhamsted	April 25	A. F. C.
Swallow (*Hirundo rustica*)	Broxbourne	,, 16	Rev. H. P. Waller.
	Berkhamsted	,, 17	Mrs. E. Mawley.
	Radlett	,, '17	H. J. Lubbock.
	St. Albans	,, 18	Mrs. J. Hopkinson.
	Harpenden	,, 18	J. J. Willis.
	Sawbridgeworth	,, 18	H. S. Rivers.
	Hunton Bridge	,, 20	H. Procter.
	Odsey	,, 20	H. G. Fordham.
	Wealdstone	,, 23	G. E. Eland.
(Last seen)	Watford	Oct. 2	Mrs. Bishop.
	Sawbridgeworth	,, 5	H. S. Rivers.
	Wealdstone	,, 8	G. E. Eland.
	Odsey	,, 10	H. G. Fordham.
	Hitchin	,, 12	A. W. Dawson.
	Berkhamsted	,, 12	Mrs. E. Mawley.
House-Martin (*Chelidon urbica*)	Hunton Bridge	May 11	H. Procter.
Sand-Martin (*Cotile riparia*)	Tring Reservoirs	Mar. 31	J. Street.
Swift (*Cypselus apus*)	Berkhamsted	April 29	A. F. C.
	Hunton Bridge	May 10	H. Procter.
Cuckoo (*Cuculus canorus*)	Berkhamsted	April 12	A. F. C.
	Broxbourne	,, 14	Rev. H. P. Waller.
	Hatfield	,, 16	T. Brown.
	Cokenach	,, 17	Miss Crossman.
	St. Albans	,, 17	Mrs. J. Hopkinson.
	Sawbridgeworth	,, 17	H. S. Rivers.
	Chandlers Cross	,, 18	H. Procter.
	Radlett	,, 19	H. J. Lubbock.
	Watford	,, 19	Mrs. Bishop.
	Harpenden	,, 20	J. J. Willis.
	Wealdstone	,, 22	G. E. Eland.
	Hitchin	,, 25	A. W. Dawson.
	Odsey	,, 26	H. G. Fordham.
Turtle-Dove (*Turtur communis*)	Hunton Bridge	May 10	H. Procter.
Common Sandpiper (*Totanus hypoleucus*)	Cokenach	April 29	Miss Crossman.

XXV.

NOTES ON LEPIDOPTERA OBSERVED IN WESTERN HERTFORDSHIRE IN 1897, 1898, AND 1899.

By Arthur Cottam, F.R.A.S.

Communicated by A. E. Gibbs, F.L.S.

Read at Watford, 10th April, 1900.

The last notes of Lepidoptera which have been published in the 'Transactions of the Hertfordshire Natural History Society' are those of Mr. S. H. Spencer, jun., of the insects observed in the neighbourhood of Watford in 1896 (Vol. IX, p. 236).

As I have been working this portion of the County during the last three years, I have taken a few insects that, so far as I have been able to ascertain, have not been recorded previously for this County, besides others the capture of which should, I think, be noted.

During the last two years Mr. Aubrey C. Stoyel has been my usual companion when out collecting. He has been making a careful list of all the Lepidoptera previously recorded in the Notes and Lists published in the Society's 'Transactions' as having been taken in Hertfordshire, which list has been of great assistance to me in preparing this paper.

There is a list by Mr. Bowyer in Vol. V of the 'Transactions,' p. 30, of Lepidoptera taken in the neighbourhood of Haileybury, which includes several species that have not been taken on this side of the County, as well as some which I am now able to record for this district for the first time.

My cousin, Mr. Philip J. Barrand, of Bushey Heath, has been working there since March, 1897, and I have included in this paper some of the insects taken by him. All recorded as taken at Bushey Heath have been captured in Hertfordshire, but the locality is not far from the Middlesex border. Some of his best captures have been made by light with a moth-trap.

The insects recorded as captured at Tring have been taken either on the bank of the Grand Junction Canal, close to Tring Station, or on the lower slopes of the chalk downs at Aldbury, and all well within the County boundary.

RHOPALOCERA.—Butterflies.

Lycæna Corydon.—The Chalk-hill blue.—Mr. Gibbs has recorded (Vol. VIII, p. 78) that this butterfly abounds at Lilley Hoo, but it does not appear to be known that it is also usually abundant on Aldbury Downs. I have taken it there every year for the last four years, and on the 2nd of August, 1899, it was out in myriads, the

whole hillside being grey with it. During a short time when the sun was obscured by clouds I counted fifteen sitting on a single plant of knapweed.

Lycæna minima (*alsus*).—The Bedford blue.—This, our smallest butterfly, is abundant on the bank of the Canal at Tring, where the kidney vetch (*Anthyllis vulneraria*), the food-plant of the larva, grows in large masses.

Hesperia comma.—The silver-spotted skipper.—This has been recorded as being taken at Broxbourne Common in 1874. Newman states that one specimen was taken on Berkhamsted Common; but that it is by no means scarce on the Aldbury downs has not previously been noted. It is a local and certainly not a common insect.

I may note in passing that there is a beech wood on the side of the hill above the rifle-butts on these downs in which *Epinephele hyperanthus*, the ringlet, abounds, though I have never seen a specimen outside the wood. I doubt whether the beauty of this somewhat dingy butterfly, when it has freshly emerged from the pupa, is generally appreciated. The scales are then a rich glossy black, and in the sunshine with a beautiful blue and green iridescence. It is so easily rubbed and so soon gets worn that it is not easy to obtain a good series.

There are, of course, several other butterflies to be taken on these downs, of which the following may be worth mentioning:—

Lycæna icarus (*alexis*).—The common blue.

L. astrarche (*agrotis*).—The brown argus.—The food-plant of this butterfly, the common rock-rose (*Helianthemum vulgare*), covers these hills.

Thecla rubi.—The green hairstreak.

Hesperia sylvanus.—The large skipper.

Nisoniades tages.—The dingy skipper.—The Aldbury specimens of this butterfly belie their English name, for they are richly and beautifully varied in colour, and are very handsome.

HETEROCERA.—Moths.

Sphinges.—Hawk-Moths.

Chærocampa porcellus.—Bushey Heath.

C. elpenor.—Bushey Heath.

Macroglossa stellatarum.—The humming-bird hawk-moth was tolerably common in 1899. It was even taken in London.

Zygena filipendulæ.—Common on the canal bank at Tring.

Bombyces.

Halias prasinana.—Bricket Wood.

H. bicolorana (*quercana*).—This moth has not been recorded as occurring in Bricket Wood. Several were seen in 1899, and Mr. Stoyel secured one, which he kindly gave to me.

Calligenia miniata.—The rosy footman or red arches.—This insect is recorded as having been taken at Haileybury, and in 1888 at Hertford. In 1899 it was abundant in Bricket Wood. From July 13th to the end of the month we took it at sugar every night that we went to the wood, and it remained in good condition to the last.

Lithosia lurideola (*complanula*) also occurred at sugar in Bricket Wood. It has not been previously recorded as taken there.

Stauropus fagi.—The lobster-moth.—On the evening of 6th July, 1899, a beautiful fresh specimen of this moth flew into my room, attracted by the light, and the following night another came to the window, which happened to be shut, and before I could open it the moth flew away, but not before I had seen clearly what it was. This insect has been recorded by Mr. Bowyer from Haileybury, but is, I think, new to this side of the County.

Notodonta chaonia.—I took one of these moths at the electric light at Bushey on 23rd May, 1898.

Lophopteryx camelina.—Both at Watford and Bushey Heath at light.

Pterostoma palpina.—At Watford at light.

Noctuæ.

I give a list of these in their proper order, omitting only the very common species which are taken always and everywhere, and I have added a note where one seems to be required.

In 1897 and 1898 "sugaring"—the best means, as a rule, of catching this group of moths—was quite useless during the summer, but the sweets became attractive in the autumn. In 1899 the reverse was the case; the summer Noctuæ came to sugar in numbers, but in the autumn hardly any came. The sallow bloom was a failure in the spring of 1899.

Where the name of a species only is given, without locality, it has been taken at Bricket Wood, Watford, and Bushey Heath in one or other of the three years included in this paper.

Thyatira decasa.—Bushey Heath.

T. batis.—Bushey Heath, and in Bricket Wood in 1898 and 1899, but very sparingly.

Cymatophora or.—Bricket Wood. Four in 1898, and a fair number in 1899.

C. duplaris.—Bricket Wood, 1899.

Asphalia diluta.—Bricket Wood, 1899, at sugar, and Watford at light.

Leucania conigera.—Watford and Bricket Wood.

L. lithargyrea.

L. comma.—Bushey Heath and Watford.

Hydræcia nictitans.

Xylophasia lithoxylea.—Bushey Heath. This usually abundant insect has not put in an appearance either at Watford or Bricket Wood.

X. hepatica.—Bricket Wood, 1899, and Bushey Heath.

Dipterygia scabriuscula (*pinastri*).—Bricket Wood and Bushey Heath.

Chareas graminis.—Flying in the daytime on the downs at Aldbury in 1897 and 1899.

Cytharea matura.

Mamestra sordida (*anceps*).—Bushey Heath.

Rusina tenebrosa.—Abundant in Bricket Wood every year.

Agrotis puta.—Bushey Heath, 1897; Bricket Wood, 1899.

A. suffusa.—Bricket Wood, 1898 and 1899.

A. saucia.—Bricket Wood, 1899.

A. corticea.—Bushey Heath.

A. cinerea.—Three males were taken at Felden, Boxmoor, at light, by Mr. Albert Piffard in 1897, and he kindly gave them to me. This is a new record for the County, and a particularly interesting one.

A. strigula (*porphyrea*).—On 18th July, 1898, a specimen of this moth flew into my room to the light. Where it can have come from is a mystery, as the nearest heather must be several miles away. It has been recorded as occurring at Haileybury and Sandridge.

Noctua augur.—Bricket Wood.

N. plecta.—Bricket Wood.

N. C-nigrum.—Bricket Wood.

N. triangulum.—Bricket Wood.

N. stigmatica (*rhomboidea*).—Bricket Wood.

N. brunnea.—Bricket Wood.

N. festiva.—Bricket Wood.

N. rubi (*bella*).—Bricket Wood.

N. baia.—Bricket Wood.

N. xanthographa.—Bricket Wood.

All these species of this genus occurred at sugar in 1899, *triangulum*, *stigmatica*, *brunnea*, and *baia* for the first time in that year. The first and last were exceedingly abundant, and I took a fair series of *stigmatica*, though it soon gets worn. Mr. Gibbs has recorded that five specimens of it were taken at Haileybury by Mr. Bowyer in 1893 (Vol. VIII, p. 74), and Mr. Griffith has taken it at Sandridge. It is by no means a common insect.

Tryphæna janthina.—At Watford at light and in Bricket Wood at sugar, in 1899.

T. fimbria.—This moth very rarely comes to sugar, but in 1899 we took about a dozen in Bricket Wood. They mostly came to the sugar on one particular oak-tree.

T. interjecta.—Bushey Heath, 1897 and 1899.

T. comes.—Bricket Wood.

Mania typica.—Bushey Heath.

M. maura.—Bricket Wood.

Tæniocampa gothica.

T. incerta (*instabilis*).—Bricket Wood.

T. stabilis.—Bricket Wood and Watford.

T. gracilis.—Bricket Wood.
T. miniosa.—Bricket Wood.
T. munda.—Bricket Wood.
T. cruda.—Bricket Wood.

This genus is mostly taken on sallow bloom in March or April. In 1898 we took several *T. munda* at sugar.

Orthosia suspecta.—Two at Bushey Heath at light in 1899. This is a very interesting new record. The insect is usually a northern species, though it has been taken in Suffolk and Essex, as well as in the New Forest. Its favourite localities are woods or commons where birches abound, and these moths may have come from Stanmore Common, which is just over the Middlesex border.

Orthosia upsilon.—Bushey Heath.
O. lota.—Bricket Wood.
O. macilenta.—Bricket Wood.
Anchocelis rufina.—Bricket Wood.
A. pistacina.
A. lunosa.—Bricket Wood and Bushey Heath.
A. litura.—Bricket Wood and Bushey Heath.
Cerastis vaccinii.—Bricket Wood.
C. spadicea.—Bricket Wood.
Scopelosoma satellitia.—Bushey Heath.
Xanthia citrago.—Bricket Wood.
X. fulvago (*cerago*).—Bricket Wood.
X. flavago (*silago*).—Bricket Wood.
X. gilvago.—Watford.
X. circellaris (*ferruginea*).—Bricket Wood and Bushey Heath.
Tethea subtusa.—One specimen at Watford, at light, 11th August, 1898.
Calymina trapezina.—Bricket Wood and Bushey Heath.
C. pyralina.—Watford and Bushey Heath, at light.
Hecatera serena.
Polia flavicincta.—Watford.
Dianthœcia carpophaga.—Watford, 1897.
Cleoceris viminalis.—Bricket Wood.
Agriopis Aprilina.—Bricket Wood, 1897 and 1898.
Euplexia lucipara.—Bricket Wood.
Phlogophora meticulosa.—Bricket Wood.
Aplecta nebulosa.—Bricket Wood, 1899.
Hadena adusta.—Bushey Heath.
H. protea.—Bushey Heath and Bricket Wood.
H. dentina.—Bushey Heath.
H. oleracea.—Bushey Heath and Watford.
H. pisi.—Watford, at light, 1897.
H. thalassina.—Watford, at light, 1897, and Bushey Heath.
H. genistæ.—Watford, at light, 1897, and Bushey Heath.
Xylocampa areola (*lithoriza*).—Bushey Heath and Bricket Wood.
Calocampa vetusta.—Bricket Wood, one, 1898.
C. exoleta.—Bricket Wood, one, 1897.
Asterocopus sphinx.—Bushey Heath.

Cucullia verbasci.—Bushey Heath.

C. chamomilæ.—On 24th April, 1898, I found a specimen at rest on the railings of Cassiobury Park. This is the fourth recorded for the County.

Gonoptera libatrix.—Bricket Wood and Bushey Heath.

Habrostola tripartita.—Bushey Heath.

H. triplasia.—Watford.

Plusia chrysitis.—Bushey Heath and Watford.

P. iota.—Watford, at light, 1897, and Bushey Heath.

P. moneta.—One at light, 1899, Bushey Heath. This is an interesting capture, showing that the species is establishing itself in this neighbourhood.

Euclidia mi.—Bricket Wood and Tring.

Catocala nupta.—Watford and Bricket Wood. Less common than usual in 1899.

There is a curious *lapsus calami* in Mr. Spencer's paper on the Lepidoptera observed in the neighbourhood of Watford in 1896, which I should like to take this opportunity to correct (Vol. IX, p. 238). *Cymatophora flavicornis* (= *or*) should be *Asphalia flavicornis*. *C. or* we have taken at Bricket Wood, as I have noted above; the larvæ which Mr. Spencer found there were that of *Asphalia flavicornis*, but I have never succeeded in finding the moth at Bricket, though I have often searched for it. I have found it in each of the last four years on Stanmore Common.

Geometræ.

We have not worked so much at the Geometers, but the following which have occurred may be worth noting.

Angerona prunaria.—Bricket Wood.

Pericallia syringaria.—Bushey Heath.

Eugonia alinaria (*tiliaria*).—Watford, at light.

E. fuscantaria.—Watford, at light.

Himera pennaria.—Watford, at light.

Tephrosia luridata (*extersaria*).—Bricket Wood. I usually take three or four specimens every year. It is not a generally common insect.

Geometra papillionaria.—Bricket Wood. Several seen, though we did not capture any.

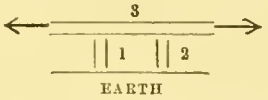
XXVI.

A CURIOUS INSTANCE OF THE LABOUR-SAVING INSTINCT IN THE LEAF-CUTTING BEES.

By Aubrey C. Stoyel.

Read at Watford, 10th April, 1900.

On the 5th of August I noticed some leaf-cutting bees flying around the open ends of a lot of bamboo-canes which had been put in the greenhouse to keep the plants upright. The canes were put in the earth after this fashion:



1, 2, and 3 being canes, of which No. 3 had the ends open, wherein the bees kept entering and coming out again.

At the time I thought nothing of it, but on the 9th of August, when making an investigation of the canes, I found the bees going into the hollow ends with pieces of leaves and presently returning without them. I let them remain undisturbed for a few days. On making my second investigation I found that the canes were filled up to the top with round pieces of the petals of the red geranium and rose-leaves, and, cutting one of the canes just above the first knot, I cut through a case of honey and pollen which had been bound up in pieces of leaves. This led to a further examination, which showed several canes to have been treated in a similar manner, as far as the first knot.

A leaf-cutting bee generally excavates a cylindrical hole about seven to ten inches in length, in a horizontal direction, either in the ground or in the trunk of a rotten tree, and sometimes in other decaying wood. This cavity she fills with cells completely composed of portions of leaves in the shape of a thimble, the convex end of one piece fitting closely into the open end of another. The first process is to form the exterior coating, which is composed of three or four pieces, of larger extent than the rest and of an oval form.

The second coating is formed of portions of uniform size, narrow at one end but gradually widening towards the other, where the width is supposed to equal half the length. One side of these pieces is the serrate margin of the leaf from which it was taken, which, as the pieces are made to lap over one another, is kept on the outside, and that which has been cut within.

The bee now forms a third coating of similar materials, of which she places the middle over the margins of those which form the first case, thus covering and strengthening the junctures. Having finished a cell, her next business is to fill it. She fills it (according to accounts) within half a line of the orifice with a brownish-red conserve of an agreeable odour, composed of honey

and pollen, and on this she deposits her eggs. Having done this, she closes the orifice with pieces of leaves so exactly circular as to fit the walls of the cylinder to a nicety. After this covering is fitted she proceeds with the next cell, and so on to, on an average, between six and nine cells, in accordance with the length of the cylinder.

In this case the bees have made use of the hollows of the canes for their cylinders, thus saving themselves the trouble of forming them. In all the other particulars I believe they have acted in their ordinary manner.

XXVII.

ORNITHOLOGICAL NOTE.

Read at Watford, 10th April, 1900.

Curious Nesting-places.—The freaks of birds in their nesting arrangements have been illustrated at Hitchin by one pair of robins building in an empty jam-pot and another in an old kettle.

On one of the allotments adjacent to London Road [Bedford] there was an old cabbage-plant that had been cut and had sprouted out again. A thrush's nest has been found built at the bottom of a three-pronged stalk of this old cabbage, and already contains eggs.— *Herts Mereury*, 29th April, 1899.

On Sunday last Mr. Ramsey of St. Andrew Street [Hertford] saw a linnet's nest containing four eggs on the top of a sprouting broccoli in a garden at Albury Hill, near Standon.—*Herts Mercury*, 6th May, 1899.

Mr. Puddephatt, of Markyate Street, had occasion to take a cart-wheel off, and he stood it in the yard between two kennels occupied by noisy yard-dogs. A robin is now sitting upon a nest built in the hub of that wheel.—*Herts Advertiser*, 27th May, 1899.

Instances of curious nesting-places at Hatfield and Codicote (of a robin and a redstart, each building in a watering-can) will be found on p. 102 of the present volume.—(*Communicated by*) *the Editor.*

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XXVIII.

NOTES ON THE PLACE-NAMES AND FIELD-NAMES OF THE PARISH OF WATFORD, HERTS.

80032

By Percy Manning, M.A., F.S.A.

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Read at Watford, 16th January, 1900.

This paper has no claim to be considered as more than an *essay*, written in the hope of calling the attention of members of this Society to a somewhat neglected subject. I am fully aware that many of the points touched upon deserve far more exhaustive treatment than I have been able to devote to them within a certain limited space.

What I have done has been to compile a list of the more interesting names in the old parish of Watford (i.e. including Oxhey and Leavesden), prefaced by (1) some general remarks on the subject of place-names, (2) an analysis of the more usual sources of nomenclature, (3) a list of the terms used to denote divisions of land.

My thanks are due to the late Rev. T. H. Kynaston, Rector of Bushey; the Rev. Lee James, Vicar of Watford; the Rev. Newton Price, Vicar of Oxhey; Messrs. Humbert & Flint, of Watford; and Mr. A. Wall, of Watford; who have either allowed me access to documents in their custody or given me help in other ways.

I. General Remarks.

The subject of place-names is one that, so far as I know, has not yet been brought under the notice of this Society, possibly because it has been thought to lie somewhat outside the range of the Society's objects. It therefore would seem well to draw your attention to some of the main facts that may be arrived at from the collection and comparison of the names of places and fields, even in so small a district as a single parish, and thus to show what claims the study of place- and field-names has to the attention of a Natural History Society.

One of the most obvious facts about place-names is the way in which they preserve, as it were, in a fossilized form, the dialect of the district; and as a branch of ethnology, dialect may fairly be said to come within the scope of a Natural History Society. For instance, a name like "Eye Spring" shows two words, one of which has long been obsolete altogether, while the other has disappeared from literary English. "Eye" is simply the Anglo-Saxon "ea"—water; "Spring" is another word for wood, and is so used in the seventeenth century by Fletcher.

The word "toft" in "Jacketts Toft" is one of many introduced by the Scandinavian invaders of this country.

Then, again, for the ethnologist, the distribution of family names is not without its significance, as has been pointed out by

Mr. Guppy,* and few records of family names are so enduring as those which are stereotyped in field-names.

Another very fertile source of place-names we have in the trees and other plants which grow in or about the places, a subject which of course comes within the scope of a Natural History Society. Such names as "Broom Field," "Crab Tree Pightle," and "Service Tree Field" will serve as examples.

The wild animals, too, of a district leave their names on their habitats, and though we cannot in this parish boast of a Beverley or Beaver's Meadow, yet the name "Otterspool" marks the favourite haunt of an animal once much more common in the Home Counties than now; and "Rail Mead" and "Swan Mead" mark the nesting-places of two well-known water-fowl.

But perhaps of more interest than these are the names which tell of the early history of agriculture, and of the growth of rural institutions. The name "Innings," i.e. reclaimed land, carries us back to a time when the inhabitants of this district were still engaged in cutting down and clearing away the thick woods which covered most of the face of the country. The name "Newlands" signifies, in the same way, land newly brought under cultivation.

An ingenious writer† on early village life points out how in India the settlers in clearing their land left a small piece with the trees standing on it, which no one was allowed to appropriate, to form a sanctuary for the woodland spirits, the propitiation of whom forms such an important feature in primitive religion. It is quite possible that this may have been the meaning of the ownerless scrap of ground called "No Man's Land" which is to be found in this as in many other parishes in England.

The intensely real belief of our forefathers in spirits and goblins is shown by the host of names such as "Devil's Dyke," "Hobb's Hole," "Lubber's Down," etc., which abound all over the country. We may perhaps trace this belief in our own parish in the name "Myryden," the "dene" or narrow valley of the "myre" or goblin. "Hagden-lane," though it may only represent the "hedge dene," may just as well allude to the "hag" or witch, especially as tradition credits this still dark lane with a ghost.

But the field-names tell us besides of the village community with its elaborate system of lands, held, not individually, but in common ownership. Fitzherbert,‡ writing in 1539, thus describes the communal system of agriculture then in use:—"To every townshyppe that standeth in tyllage in the playne country, there be errable lands to plowe and sowe, and leyse to tye or tedder theyr horses and mares upon, and common pasture to kepe and pasture their eatell beestes, and shepe upon, and also they have medowe grounde to get theyr hay upon." Such a community Watford must have been.

* H. B. Guppy: 'Homes of Family Names.'
† G. L. Gomme: 'Village Community.'
‡ 'Book of Surveying and Improvement.'

Some of its "errable" (i.e. arable) lands remained unenclosed within living memory, and their name is preserved in "Watford Field House," which adjoined them. Watford Field was known as "Lammas Land" because it was thrown open on Lammas Day (August 1st) after the crops were cleared off, to be pastured over by the commoners' cattle. These arable fields were divided into "furlongs," or as they were called in some parts of the county, "shots," whence come the names "Legger Shots," "Upper Shotts," and "Stanishot." The "furlongs" or "shots" were divided into long and narrow strips called "acres," a word surviving in "Tithe Acre" and "Starve Acre." The acres were separated from each other by narrow strips of turf known as "balks," shown in the name "Mare Balks." Across the *butt* or end of an "acre" sometimes ran a short broad strip of land called a "butt," which explains the name "Colney Butts." The "acres" were ploughed into parallel ridges and furrows, called "lands," the one which adjoined the edge of the field being known as the "Sideland." Hence the name "Sideland Mead."

Next we come to the "leyse [i.e. leys or leas—meadows] to tye or tedder theyr horses and mares upon." These leys were strips of grass land lying in the open fields mixed up with the strips of arable. Thus in a terrier of 1751, at Orlingbury, Northants, we find in one of the open fields called "Snortwell Field," "three leyes" described as "Grass Ground Horse Pasture." Consequently the horses and mares had to be tethered on the grass to prevent them from straying on to the arable strips. Such "leys" have left their names in "Lea Mead," "Lay Pightle," "Lea Farm," and "Lees Wood." Sometimes, however, a definite piece of land was set aside for the horses, distinct from the open field, as we see from the name "Horse Moor," a *moor* being a rough pasture by a river.

The "common pasture" for "catell beestes and shepe" was parted from the arable fields by hedges. It was of more than one kind. Some pastures lay along the river-side, and consisted of rough coarse grass, such as may still be seen on Watford "Common Moor." The "Cow Moor" and the "Ox Pasture" must have been of a similar kind. Other pasture was on the higher ground covered with furze or heath, of which the small common called "Watford Heath" is the last survival in the parish. A third kind of pasture was to be found in the woods, which afforded beechmast or acorns for the swine. "Common Wood Common," although now cleared of trees, represents the remains of this woodland pasture. The geese, too, had their feeding-grounds provided, as we see from the names "Goose Clack" and "Gander's Pye."

The people of Watford also had their "medowe groundes to get theyr hay upon." These meadows, like the arable lands, were divided into strips, which were marked out by rows of stones or wooden posts. It was customary to cast lots for these pieces of meadow, so as to give all a chance of getting a good piece. Watford "Common Mead," adjoining the Lammas Lands, was

enclosed some 40 years back, and the drawing of lots now only survives in the name "Lot Mead." There is, however, in the neighbouring parish of St. Stephen's, on the banks of the Colne between Munden and Hansteads, a piece of unenclosed meadow which still shows the posts dividing up the different lots. Sometimes the whole of the common lands was not distributed among the commoners. It was often the practice to put up strips of land to auction for their benefit. It is on record that such a piece of land at Bampton, Oxon, which generally fetched a penny, bore the name of "Penny Ham," and probably "Sixpenny Hill" in this parish owes its name to a like custom.

As the cattle of the commoners were at liberty to wander over considerable tracts of pasture without fences to keep them in, it was necessary to keep watch over them, and the commoners therefore appointed a cow-ward or cowman, who was paid for his services out of the proceeds of the "Cowman's Field." It was the cowman's duty to see that no commoner should turn out to pasture more cattle than the size of his holding entitled him to, and any beasts found in excess of the right number were liable to be seized and placed in the "Pound," which gave its name to "Pound Field."

Another important village officer was the smith, who gave his services to the community in return for the proceeds of the "Blacksmith's Field."

The village festivals formed an important item in the life of such a community as I have sketched. Christmas, Easter, Whitsuntide, Lammastide, with a host of other feasts, were all the signal for merrymaking, fully recognized and organized by the village authorities. The "Piper's Field" recalls the time when a piece of land was set aside to pay the village piper, who provided the music for these festivities. A passage from Scott's "Old Mortality" may well be quoted in illustration: "Niel [Blane] had gained the official situation of town-piper of —— by his merit, with all the emoluments thereof; namely, the Piper's Croft as it is still called, a field of about an acre in extent; five merks, and a new livery-coat of the town's colours, yearly . . . ."

But even from early times, the change from common to individual ownership was in progress. The numberless "crofts," "closes," "pightles," "slipes," and "tofts" all tell a tale of slow encroachment by private owners on the common lands immediately adjoining their dwellings. All that was required was the suspense of the periodical redistribution of common lands in favour of individuals, and the tenure of a particular piece of land would then become fixed. The process may sometimes be seen going on; e.g., "A close, inclosed out of Pondfield" (Terrier of 1638, Little Berkhamstead, Herts).*

We may learn not only something of a bygone system of land-tenure, but also the nature of the crops grown, from our field-names.

* 'Herts Genealogist and Antiquary,' vol. ii, p. 110.

The name "Hop Field," in this and other parishes, recalls the time when Hertfordshire, although now no longer a hop-growing county, grew enough hops to supply its local needs.

Besides the village community, the manorial system has left its traces on the place-names. The name of "Black Park," belonging to a field close to Oxhey Place, records the fact that that house, now only a farm, was once the site of an important Manor to which a park was attached as early as the reign of Edward I. The "Dovehouse Field," close by, is a survival from the time when the privilege of keeping pigeons was one jealously reserved by the Lord of the Manor to himself. In the long winters, when fresh meat was unobtainable—for all beasts except those required for breeding were killed and salted down—the pigeons formed an important item of food. The name "Tolpits," or "Tolpade" as it was written in the fourteenth century, perhaps indicates the tollpath, or the path by which the tenants went to pay their toll for grinding corn at their lord's watermill, which then stood on the River Colne at the place referred to.

The student of local archæology and history may also find materials of interest in place-names. In "High-street Farm" we have one of the very few Latin words which the Anglo-Saxon conquerors of this country took over from the Romanized Britons. The roads were a monument of Roman rule which they could not destroy, and so the Latin "stratum" became the Saxon "street." "High-street Farm" seems to mark the line of a branch road which left Akeman Street near Tring, and, running along the high ground parallel to the valley of the Gade, passes through Bovingdon towards Rickmansworth.

As an instance of the history of later days illustrated in a place-name, we may quote "Edeswick," a seventeenth-century name for Oxhey Lodge. The manor of Oxhey was held in the time of Edward the Confessor by Alwin the Huntsman, "the man of Queen Edith," and it is not too much to suppose that "Edeswick" is a contracted form of "Eddida's Wick."

The philologist may find some interest in tracing the changes and corruptions of place-names, changes due sometimes to the natural decay of language, sometimes to the endeavour to reduce to writing a word imperfectly heard by the writer. As an instance of the former, we may take the progress of the name Cassio, from its earliest form "Caegesho" through "Caysho" to its present form. It may be observed in passing that the history of this name affords an excellent illustration of the saying, "Mythology is a disease of language." The degenerate form "Cassio" is responsible for the story set on foot by the historians of the seventeenth century, that the place took its name from the British prince Cassivelaunus, who had here his royal palace!

Or, again, who would imagine that the nineteenth-century "Twopits" represented the fourteenth-century "Tolpade"? And yet this is the form given to the word by the compilers of the Ordnance map of 1822. Or who but one familiar with the

local history would recognize "St. Clair" in the word "Sinklees" or "Sinkleys"? Misreading of manuscripts may give rise to new corruptions. The compiler of this paper thought he had found the name of a new Saint in "St. Foyn Field," and it was only after some while that he realized that the name might also be written "Sanfoin Field." Lastly, field-names sometimes preserve a touch of real humour. One can imagine the wrath and despair of the farmer who christened an obstinately barren piece of land "Dry-and-be-damned Field."

It will, I think, be apparent from these remarks that the study of field-names is one which may well attract more attention than hitherto from students of Natural History, as well as from archæologists and antiquaries. If members of this Society would devote themselves each to the names of his own parish, we should get together a mass of material which would be invaluable for purposes of comparative study.

The following is a list of the chief authorities used in this paper, and of the abbreviations used in referring to them:—

Ordnance Survey, 1 inch to a mile, 1822. (Old O.S.)
Ordnance Survey, 6 inches to a mile, 1877. (New O.S.)
MS. Tithe Book, compiled 1803. (T.B.)
MS. Tithe Rent Charge Book, compiled 1854. (T.R.B.)
Chronicles of St. Albans Abbey, Rolls Series.
1. Gesta Abbatum Monasterii S. Albani. (Gesta.)
2. Registrum Abbatis Johannis Whethamstede. (Reg. Whet.)
Cussans' History of Hertfordshire. (Cuss.)
H. Williams' History of Watford, 1884. (Will.)
Herts Genealogist and Antiquary, ed. W. Briggs, 1895. (H.G.)
Halliwell-Phillipps' Dictionary of Archaic and Provincial Words. (H.P.)
Rev. Newton Price, Charter of Oxhey. (Ch. Ox.)

II. Chief Sources of Nomenclature in Field-Names.

(These are given in the order of their relative frequency.)

1. Owner, past or present, e.g. Abraham's Close, Woolmer's Field.
2. Size, e.g. Eight Acre Field.
3. (*a*) The farmhouse and its accessories:
   Barn Field, Buildings F., Cart-house F., Clamp F., Cottage F., Dog Kennel F., Dovehouse F., Fishpond F., Garden F., Gate F., Gatehouse F., Hayhouse F., Hogsty Pightle, Hog-trough F., House F., Pump Mead, Rick Mead, Rickyard Mead, Sheepcote F., Sheephouse F., Soot House F., Stable F., Stack F., Well F., Watering Place F.
   (*b*) Buildings, etc., used in other industries:
   Chalk Dell Field, Clay Pit F., Gravel Pit F., Sand Pit F., Brick Kiln F., Kiln F., Lime Kiln F., Mill F., Sawpit F., Silk-shop F., Wharf Mead.

4. Trees or shrubs:
   Appletree Field, Beech Spring, Birch Spring, Briar Hill, Broom F., Burnt Oak F., Bush F., Cherry Croft, Crab Tree Pightle, Elm Grove, Furze F., Gander's Ash, Heath F., High Elms, Holly Bush F., Nut F., Nutbeam F., Oak F., Peartree F., Service Tree F., Shrub F., Tree F., Walnut Tree F., Willow Hedge F.
5. Relative position:
   Home Field (31 times), Eastbury, East Lane F., Further, Inner, Lower, Middle F., Nearer Mead, North F., Third F., Under Acre, Upper F., Westmede.
6. Nature of the soil:
   Callow Land, Clays, Clay Hills, Dry-and-be-damned Field, Gravelly F., Hungerlands, Mauls or Marlings, Poor Hill, Poor Wheat Stubble, Rushy Mead, Sand F., Starve Acre, Stoney Piece, Thistley F.
7. Physical configuration of the ground:
   Bottom Field, Brook Mead, Dell F., Groundfall F., Gully F., Gullett Wood, Hangings, Hanging Hill, Hill F., River Mead, Up and Down F., Waterdell F.
8. Wild animals:
   Deer Spring, Foxdell Field, Foxhole F., Hare Brake (H. Bush, H. Field, H. Hills, H. Wood), Otterspool, Rabbit Warren Wood, Rail Mead, Swan Mead.
9. Shape:
   Corners Field, Crook F., Round Mead, The Roundabout, Shoulder of Mutton F., Three Corner F.
10. Crops:
    Bean Field, Carrot F., Hop F., Lucerne F., Peseeroft, Potato F., Rye Hill, Sanfoin F.

III. Words indicating Divisions of Land.

Acre, e.g. "Starve Acre," "Tithe Acre." The word originally meant an open piece of arable land, then it came to mean a strip of arable of varying extent in an unenclosed common field. It was only later that it came to have its present restricted meaning as a definite measure of land. The "acre," as used in its second sense, may have measured 160 poles, but very often measured more or less. Thus "Long Acre" at Little Berkhamsted, Herts, actually measured 1a. 1r. 27p. (H.G., ii. 183).

Balk, e.g. "Mare Baulks." A ridge of land left unploughed between the strips of arable in an open field. From A.S. *balc*, cf. *bulk* and *bulge*, i.e. something raised. For the literary use of the word, cf. Browne:

> "And as the plowman when the land he tills
> Throws up the fruitfull earth in ridged hills
> Between whose chevron form he leaves a *balke*."
>
> ('*Britannia's Pastoral*,' i. 1. 1613.)

Butt, e.g. "Colney Butts," "Butt Field." A short piece of arable lying across the *butt* or end of one of the "acres" in an open field. An "acre" was said to "butt on" its boundary, e.g. "two acres buttinge upon the Warren Hedge" (Terrier of 1638, Clothall, Herts; H.G., ii, 225).

Close, e.g. "Lady's Close," "Orchard Close." An *enclosed* piece of land, held in individual ownership, as distinguished from the open fields, which were held in common.

Croft, e.g. "Barn Croft," "Golden Croft." A small enclosure, generally adjoining a house.

Ground, e.g. "Furze Ground," "Grazing Ground." A piece of meadow or pasture, often of rough character.

Land, e.g. "Tooley's Land," "Sidelands Mead." Originally an open space cleared in a wood for cultivation, cf. English *lawn*, Welsh *llan*: applied (1) to arable land in general; (2) in a restricted sense, to the ridges into which arable land is thrown up in ploughing, e.g. "a shott [i.e. portion] of 3 landes" (Terrier of 1638, Bennington, Herts; H.G., ii, 109).

Lea (or *ley*), e.g. "Lea Mead," "Lay Pightle." (1) Meadow land in general, e.g. "One close of ley ground" (Deed of 1629, relating to Dame Morison's Charity at Watford); (2) a strip of grass pasture in an open arable field, e.g. "Grasse in the little fielde; one ley against Harrowden Brooke" (Terrier of 1751, Orlingbury, Northants).

Pickle, *Pightle*, e.g. "Lower Pickel," "Dell Pightle." A small enclosure near a house, e.g. "a garden, a little pickle of ground adjoining to it" (Terrier of 1638 at Aldenham, Herts; H.G., ii, 23); "one pightell of Pasture adjoyning to y^{e} Rectory" (Terrier of 1686 at Ayot St. Lawrence, Herts; H.G., ii, 71). "Pickel" or "pickle" seems to mean a small piece of land *picked* off from an open field. One can see the word in process of formation, e.g.: "One roode and half being a *pickt* headland to some part of the 8 acres piece" (Terrier of 1638 at Caldecott, Herts; H.G., ii, 225). "One peece of Earrable land called *Piked* peece" (Terrier of 1638, Ashwell, Herts; H.G., ii, 67). "One Piele Leye at the lane's End" (MS. Terrier of 1751 at Orlingbury, Northants). All these passages refer to pieces of land in open fields. "Pightle" or "pightel" seems to come from the verb *pitch*, through its obsolete past participle *pight*, and probably means a piece of ground *pitched* or set out, to separate it from the open field.

Piece, e.g. "Bridge Piece," "Payne's Piece." A division of arable land in an open field, e.g. "One peece of Earrable land called Piked peece" (Terrier of 1638 at Ashwell, Herts; H.G., ii, 67).

Plat (or *plot*), e.g. "Plat Field," "Margaret's Plot." A *flat* piece of land.

Shot, e.g. "Legger Shott," "Upper Shot." A division of land in an arable field. A.S. *sceat*, a portion, e.g. "a Piece [of arable] in a shott" (Terrier of 1638 at Bennington, Herts; H.G., ii, 109).

Slipe, a long narrow *slip* of land, generally meadow or pasture. At Oxford, a strip of ground between the City Wall and the Ditch is known as "The Slipe."

Spring, e g. "Main Spring," "Beech Spring." A wood; connected with *sprig*, *spray*. Cf. Fletcher, "The nightingale within the thick-leav'd spring" ('Faithful Shepherdess,' v, 1. 1613).

Toft, e.g. "Jacketts Toft." Used in two senses: (1) a grassy knoll; e.g., "a toft called the Hill," in deed of 1629 relating to property at Watford. (2) A grass enclosure adjoining a farmhouse. A word of Scandinavian origin; cf. Icelandic *topt*, *toft*, *tomt*, a clearing.

IV. List of Place-Names in Watford Parish,

With a note on the names "Watford" and "Cashio."

The name "Watford," so far as I can find, first occurs in the year 944,* and is then spelled precisely as it is now. It is found again in 1007,† and once more during the early part of the eleventh century.‡ But in none of these cases does it seem to include more than the land immediately adjoining the ford over the River Colne, now represented by Watford Bridge.

The district now comprised in the parish was known at the time of the compilation of Domesday Book (*cir.* 1080) as "Chaissou" or "Caissou," the Norman-French rendering of the Saxon "Caegesho" or "Caysho," now "Cashio." Mr. Cussans § would place the original village of Caissou "on the brow of the gently rising acclivity from the river [Colne] about a mile south-west of Watford Church" His chief reason seems to be that in a fourteenth-century deed, "Tolpade," now "Tolpits," is described as being "*in villa de Caishoo*," in the township of Caishoo. But we find that in the time of Edward I, the Hundred usually called "Caisho Hundred" is called "Caysford Hundred," ‖ and even as late as 1428 we find the name "Caysforthe."

I am inclined to think that the present Cashio Hamlet represents the old Caegesho, situated as it is at the intersection of two early roads, one from St. Albans to Rickmansworth, the other from London to Tring. Then as the traffic over the *wat-ford* increased during the latter part of the eleventh century, the centre of population seems to have drifted down the hill towards the River Colne, until it occupied the site of the present church and market-place of Watford. The change must have been over in the early

* Kemble: '*Codex Diplomaticus*,' No. 410.
† Ibid., No. 1304.
‡ Ibid., No. 920.
§ 'Cass. Hund.,' p. 166.
‖ 'Hundred Rolls,' i, 190.

part of the twelfth century, for Henry I granted a market at *Watford*, not at Caysho, to the monks of St. Albans; and the parish church of Watford, which of course marks the centre of population, contains fragments of a building not later than *cir.* 1150. The old name of "Caysho" was then gradually superseded by "Watford," the struggle between them being shown in the intermediate form "Caysford."

Now as to the meanings of the two names. The earliest mention of Caisho is in a grant of King Offa (dated 793) to the monks of St. Albans, when it occurs as "Caegesho."* Professor Earle suggests that it "seems to mean the *ho* or bank or mound of the *key* (A.S. caeg), possibly a sepulchral barrow from which an ancient key had attracted attention." The form "Caegesho" passes by natural phonetic decay into "Caeyesho," and so into "Caysho," which is the form found (with varieties of spelling, e.g. Cayso, Kaysho, Caishoo) up to the sixteenth century. It is not until the end of this century that we find the spelling Cashio or Cassio, which gave rise to the stories about the place having derived its name from Cassivelaunus, the British chieftain. Equally groundless is Salmon's guess, "Gades-ho," the hill by the Gade.

The name Watford has been explained in divers ways. Chauncy derives it from "Wet Ford," the deep ford that *wetted* passers-by. Mr. Cussans suggests *wade-ford*, "the ford mid-body deep." Others have suggested "wattle-ford," the ford protected by wattles or hurdles. Others again, "Watling-ford," because it is on a branch of Watling Street. But as the name has been consistently spelled Watford throughout its history, I suppose old Chauncy's derivation still holds good.

The letters (O) or (L) before a name show that it is in the hamlets of Oxhey or Leavesden respectively.

The date following each name is the earliest at which I have at present been able to find it.

A.S. = Anglo-Saxon.

Abraham's Close, 1808.

Acre Pightle. Vide pp. 199, 200.

(O) Aesculvescroft, *cir.* 1290 (Gesta, i, 479). Aesculf is a common Anglo-Saxon personal name. It is perhaps now represented by *Ash House* Field, on the border of Oxhey, but in Bushey Parish. By natural phonetic decay *Aesc-ulves* would become *Ash-u(l)ves*, *Ash-use*, *Ash-house*.

(L) Albon's Field, 1854; occurs as Elbon's in 1803.

(O) Amey Land, 1854. In 1392 we find a John Amys in the adjoining parish of Rickmansworth (Cuss., 'Cashio Hund.,' p. 137).

Arming Wick, 1803. Almond Wick in a plan of 1777.

Arnott's Ground, 1803. The name of Arnott occurs twice in the Bushey Register about 1740, and as a field-name at Rickmansworth.

Arshall, 1803.

* 'Codex Diplomaticus,' No. 162.

(O) Baker's Hill, 1854.

Baldwin's Field, 1854. John Baldwin, of Redheath, was buried at Watford in 1539; the last Baldwin of Redheath died in 1710 (Cuss., 'Cashio Hund.,' p. 183).

(L) Barebones, 1854.

Barnett's Croft, 1854. An Agnes Barnett, of Rickmansworth, was married in 1625 (H.G., i, 285).

(O) Battam's Field, 1854.

Beech Spring, 1854. Vide pp. 199, 201.

Bellsize Field, 1854; Bellsiers, 1803. The latter is the more correct form.

(O) Bird's Field, 1854. Hugh Bird, of Pinner, had a lease of the manor of Wiggenhall in Oxhey, from St. Albans Abbey, in 1538 (Cuss., 'Cashio Hund.,' p. 173).

Black Field, 1803. *Black* applies probably not to the colour of the soil, but to the darkness caused by thick wood; cf. e.g. Blackbush Field.

(O) Black Park, 1854. This name belongs to a field on the north of Oxhey Place; David de Jarpenville had a park here as early as 1275 ('Hundred Rolls,' i, 190).

Blackbush Mead, 1803.

Blackett's Wood, 1803. William Blaket held land in Caisho and Watford in 1260–1290 (Gesta, i, 476); Bartholomew Blaket was witness to a deed of 1363 concerning the Brightwells property (Gesta, iii, 81); and a deed of 1456 speaks of a "curtilage called Blaketts" (Reg. Whet., i, 123).

Blackpits Field, 1854.

Blacksmith's Field, 1854. Vide p. 196.

Blackwater Pightle, 1803.

Bloom Field, 1854. Probably from A.S. *bloma*, a lump.

Bluestone Field, 1854. Bluestone is the same as the old "blue vitriol," i.e. copper sulphate, used as a dressing for land.

Boney Wood, 1803. Occurs in 1608 as Boning W. (Add. MS. 16,273, f. 7, Brit. Mus.) and in 1854 as Bonny W. A Nicholas Bonny was a party to a suit about land in Oxhey in 1384 (Gesta, iii, 229).

(O) Borwe Field, 1384. Modern *burrow*, rabbit warren.

Bottom Field. 1854. In this sense like the Icelandic *botne*, a narrow valley.

Brangley Field, 1854. *Brang* appears also in Branksome Chine, near Bournemouth; it comes from the same root as the Icelandic *bringa*, a grassy slope; cf. Eng. *brink*.

Brightwells. 1854. The name first appears, so far as I can find, between 1214 and 1245, as Brittewell; there is still a well, which has been converted into a drinking-fountain.

Browning's Field, 1854.

Buckminster Field, 1854; probably a mistake for "Buckmaster." A Henry Buckmaster, of Watford, miller, was married in 1666 (H.G., i, 361).

Buck's Bottom, 1854. Probably named after Sir William Buck, who bought "The Grove" estate in 1703 (Cuss., 'Cashio Hund.,' p. 169).

(O) Burnt Oak, 1854. As Mr. Newton Price points out, this tree, which until late years marked the boundary between Oxhey and Pinner, is the successor of the "Small Oak" mentioned in King Ethelred's Charter of 1007 as even then a well-known boundary-mark (Ox. Ch.).

Bury Bushes, 1854. This wood skirts Langleybury.

Butcher's Field, 1854. Vide Blacksmith's Field.

Butt Field, 1803. Vide p. 200.

Callipers Hall, 1854.

Callow Land. "Callow, the stratum of vegetable earth lying above gravel, sand, etc., which must be removed in order to reach them; East country" (H.P.). In Oxfordshire, top soil of a hungry clayey nature.

(O) Calvert's Croft, 1803.

Camp Field, 1803. Most likely the French *champ*, a field. It must have this meaning in the compound *camp*-sheathing or *camp*-shedding—boarding put up along a river's edge to prevent the bank from being washed away.

Campion's Field, 1629.

(O) Carpenders, 1854. A Richard le Carpenter was concerned in a lawsuit at Bushey in 1374 (Gesta, iii, 229); a deed of 1456 mentions a messuage in Watford called Carpenter atte Hill (Reg. Whet., i, 229); and Thomas Carpender, Esq., was buried in Watford Church in 1677.

Carter's Hill, 1854. A John Carter was married at Watford in 1539 (Register); and Richard Carter bought half the Manor of Garston from the Crown in 1544 (Cuss., 'Cashio Hund.,' p. 186).

Cassiobury or Cashiobury. Vide p. 202.

(L) Chalk Dell Field, 1854. Dell comes from the same root as *dale*.

Chandler's Cross, 1854. William Chandler, of St. Albans, was juror in an inquisition on certain lands at Rickmansworth in 1392 (Cuss., 'Cashio Hund.,' p. 137).

(L) Charley Field, 1854. A.S. *ceorl-leag*, churl's meadow; cf. Chorleywood near Rickmansworth, often pronounced Charley.

Chelsea Mead, 1803. A.S. *ceoles-ige*, keel's (i.e. ship's) isle.

Chipperfield. A.S. *ceap*, cattle.

Chowing's Field, 1803.

Church Aite, 1803. Better spelt eyot, A.S. *igod*, isle; this has belonged to the Church from time out of mind.

Clamp Field, 1854. "Clamp; a mound of earth lined with straw to keep potatoes, beetroots, or turnips, through the winter; East country" (H.P.).

(O) Cobbecroft, 1379 (Gesta, iii, 235). *Cob* or *cop* is an Oxfordshire word for a small haystack; it also means a knoll, e.g. Adwell Cop, Oxfordshire.

Cod Croft, 1803.

Coke Field, 1803.

(L) Cold Harbour Mead, 1808. It is impossible to enter here into any discussion on the vexed question of the derivation of "Cold Harbour." Those who care to see into what extravagancies philologists have rushed will find a good summary in 'Notes and Queries,' 8th series, xii, 482. I will here only point out that the name is one of a large class into which the word "Cold" enters, e.g., Cold Norton, Cold End, Cold Comfort, Cold Ford, etc. It also occurs in Germany as "Kalte Herberge." Any theory which explains one of these names must explain all. If the name merely means "cold," how is it that it is sometimes spelled "Cole"? The last word still remains to be said on this subject.

Cole Kings, 1854.

Coleborne's Close, 1854. Nicholas Coleborne, gent., was buried in Watford Church in 1630. Nicholas C., a "beer brewer," was married in 1636 (H.G., i, 297); Christopher C. was a cordwainer of Watford in 1633 (H.G., i, 289).

Coleman's Field, 1854.

(L) Cole's Bottom, 1854.

(O) Colliers, 1854. An Andrew Colyer held land in Watford in 1456 (Reg. Whet., i, 223).

Colney Butts, 1608. The most obvious derivation is Colne-ey, Colne isle, and we might compare Colney Street, London Colney; but in one or two of the old maps, e.g. Morden's (1730), the word is spelt Colway, as if for Colne-way; lastly, in a deed of 1364, the river itself is called "the Colneye" (Cuss., 'Cashio Hund.,' p. 137).

(O) Coteswyk Grove, 1456 (Reg. Whet., i, 223).

Cowman's Field, 1803. Vide Blacksmith's Field, and p. 196.

(O) Cox's Mead, 1854.

Crail Field, 1803.

(L) Crane Hills, 1854.

Crown Field, 1854.

Curst Hedge, 1854. Perhaps the same as Corsey Hedge, 1808; possibly a corruption of *causey*, French *chaussée*, which has itself been corrupted into *causeway*.

Cut Croft, 1854. Cut is used by Chaucer in the sense of lot or portion.

(O) (Tommy) Deacon's Hill. Named after Thomas Deacon of Wiggenhall, who was buried at Watford in 1780: the family is a very old one; a John Dekene of Watford is mentioned between 1260 and 1290 (Gesta, i, 480).

Deal Field, 1803. Probably A.S. *dæl*, a dole or portion.

Dean Field, 1854. *Dene*, a narrow valley.

Deer Spring, 1854. This is a narrow strip of plantation separating Cashiobury Park from Grove Mill Lane. The ownership of a certain deer-park in Shropshire carries with it the right of cutting timber for a space of five yards

outside the park fence, and this is called the "right of the *buck's leap*"; around Richmond Park the Crown claims the land for sixteen feet outside the fence; and at Wrottesley Park, in Staffordshire, a similar surrounding belt is called the "*Deer-leap*" or "Deer-spring" ('Folk Lore,' vol. iii, p. 427). I would suggest that here we have a parallel instance, though the Deer Spring is now within the fence.

Diamond's Garden, 1854.

(O) Dingleys, 1854.

Doctor's Pightle, 1854.

(O) Dove House Field, 1854. This is the manorial dovecote at Oxhey Place.

Dry-and-be-damned Field, 1803.

Durrant's Lane, 1854. Roger Durrant, alias Estbury, of Rickmansworth, married Alice Baldwin, of Watford, in 1603 (H.G., i, 177).

(O) Dyer's Field, 1854.

Eastbury. The first mention that I can find is in 1290 (Gesta, ii, 5).

(O) Edeswick, 1601 (Cuss., 'Cashio Hund.,' p. 174), now Oxhey Lodge; vide p. 197.

Ewlings, 1854.

Eye Spring, 1803. A.S. *ea*, water.

Fane Hills, 1803.

Featherbed Lane, 1803.

(O) Finches Hill, 1854. A William Finch of Watford died *cir.* 1544 (Cuss., 'Cashio Hund.,' p. 184), and the Finch family has owned the Redheath estate from 1710 to the present day.

(L) Fortune's Farm, 1854. John Fortune was witness of a grant of Garston Manor to St. Albans Abbey in 1455 (Reg. Whet., i, 189).

(O) Fox Dell Field, 1803.

(O) Frith Ground, 1854. Welsh *fridd*, a wood. Halliwell-Phillipps gives several slight variations in meaning from different dialects, but the underlying meaning seems to be land cleared from wood and used as rough pasture, sometimes partially covered with brushwood.

(O) Froghall, 1854. The name occurs frequently in Middlesex, Bucks, and Herts; sometimes as Froghole; cf. Frogmore, Frognal. It may be connected with *frough*, loose, spongy, brittle (H.P.); I have met with the word in Oxfordshire. Or it may simply allude to the frogs that inhabit a swampy place.

Galpyns, 1456 (Reg. Whet., i, 229).

Gammon's Farm, 1883.

(L) Gander's Ash, 1854.

Gander's Pye, 1854.

(L) Garsmouth, 1854; Gosmers, 1808. Perhaps from *gore*, a triangular piece of land, A.S. *gar*, a sharp point; cf. Kensington *Gore*, and *gar-lic*, the pointed plant.

(L) Garston, either *gore-stone*, or from A.S. *gærs-ton*, a grassy place.

(O) Gibb's Couch, 1808–54. A Thomas Gibb, of Bushey, was married in 1717 (Register); "couch" is probably a softened form of *quick*, in the sense of "growing," corresponding to the double form in A.S. *cuc* and *cwic*; cf. *quitch*-grass and *couch*-grass. The word "quick" was used to denote a hedge or clump of bushes in Northamptonshire; "seven leyes on the fallows, with two *quicks*" (Terrier of 1751, Orlingbury, Northants).

(L) Golden Croft, 1854.

Goose Clack, 1803. "Clag, a bog; clag, to stick. North country" (H.P.). A.S. *claeg*, clay.

Grub Field, 1803.

Gully or Gullett Field, 1854.

Hagden Lane, 1883. Vide p. 194.

(O) Hammond Slough, 1854.

(O) Hamper Mill, 1854.

Hampstead or Hemstead Field, 1803. As this field is on the banks of the Colne, it probably is A.S. *ham-stath*, home-bank; the form Hemstead is nearer the Danish *hjem*, German *heim*.

(O) Hansey Down, 1803. In a deed of 1379 (Gesta, iii, 235) the name Hausexdone occurs; as 'u' and 'n' are easily confused in the MS., it is probable that the same place is meant in both cases.

(L) Harebrake, 1854.

Harrack's Wood, 1854.

(O) Harvey's, 1854.

Harwoods. First mentioned in 1544 (Newcome's 'History of St. Albans,' p. 486); called Harwards in a grant of James I in 1605; Horwoods in 1608 (Add. MSS. 16,273, f. 7). Rich. Horwood is mentioned in the will of John Olyve, of Watford, 1429 (H.G., i, 232).

Hatter's Farm, 1629. Another name for Brightwells.

(O) Hickman's Field, 1854. Henry Hickman, yeoman, died seised of the manor of Bournehall in Bushey in 1594 (Cuss., 'Dacorum Hund.,' p. 225).

High Elms, 1877.

High-street Farm, 1877. This name marks the line of a (probable) Romano-British road, which runs north-west and south-east along the watershed between the Chess on the south and west and the Gade and Bulbourne on the north and east. It is represented by the modern road from Chandler's Cross to Bovingdon, and can be traced by the names *Street* Farm and Kent *Street* Farm in Bovingdon parish, Friday *Street* Farm close to Ashlyns, and probably Shooters-*way* Farm in Northchurch parish. It appears to join Akeman Street and the Icknield Way at Tring. To the south-east its course is not clear; probably it ran over Croxley Green, east of Rickmansworth,

and by Batchworth Heath into Ruislip parish, where there is a Bury *Street*.

Hillipers, 1854.

(O) Hochecroft, 1379 (Gesta, iii, 235). Kennett, in the Glossary appended to his 'Parochial Antiquities,' gives "hoke, a hook, nook, or corner," and the word is used in the same way in a terrier of *circ.* 1730 at Water Stratford, Bucks; "a Hook in Stop's Close."

Holm Mede, 1260–1290 (Gesta, i, 479). A.S. *holm*, an island.

(L) Honey Croft, 1854.

Houded Wood, 1803.

How Field, 1803. An Edward How was an innkeeper at Watford in 1636 (Taylor's 'Catalogue of Tavernes about London').

Howard's Hill, 1854. A Francis Howard was married at Bushey in 1684 (Register).

Hulens, 1803.

Hulls, 1854. I find a Matthew Hull of Watford in 1635 (H.G., i, 177).

(O) Hungarys or Hungerlands. "Poor, unproductive, barren soil; North country" (H.P.). Cf. Starve Acre.

Hunt's Piece, 1803.

Innings, Great, 1854. Ainsworth gives "land reclaimed from the sea"; here it must be land reclaimed from marsh or wood.

Jacketts Toft, 1629. The name Jacott's Hill is still borne by part of Cashiobury Park, where I have been able to trace the old enclosures, and the marks of ridge and furrow, probably destroyed when the great avenue of lime-trees was planted by Le Notre about 1689; the word "toft" shows that there was a farmhouse here, probably that whose foundations are still visible under the turf. Eliz. J. of Bushey was married in 1639 (H.G., i, 217). Wm. J. of Oxhey, 1545 (H.G., i, 228).

Joan Field, 1854.

Kingsland, 1629. This field is not far from what was once the Royal Park at King's Langley.

(L) Kites, 1854.

Lady's Close. Possibly the name of a field appropriated in pre-Reformation times to the support of an altar to the Virgin; cf. Lady's Slipper and many common flower-names.

Larkes Hill, 1803.

Leavesden. Levesden in Norden's Map, 1593; probably from some A.S name, such as *Leofric* or *Leofwine*; a Leofwinesdene occurs in Hants (Kemble, '*Codex Diplomaticus*,' No. 763).

Leggatt's Farm, 1854.

Leggershot, 1803. "Lagger, a green lane or narrow strip of ground; West country" (H.P.); A.S. *lecgan*, to lay down. Vide p. 201.

Leight Field, 1803.

(L) Lemon Field. Robt. Lemon, of Watford, married 1639 (H.G., i, 217).
(O) Lenedy or Lentedy Mead, 1357 (Gesta, iii, 90).
Lewin's Field, 1854. A John Lewin died at Bushey in 1728 (Register).
Lot Mead, 1803. Vide p. 196.
Love Lane, 1854.
Mainspring, 1854.
(O) Malls, Malins, Mauls, 1803. "Mauls; clayey, sticky soil; East country" (H.P.); probably connected with *malm* or *maulm*, an Oxfordshire word for sandy limestone; A.S. *mealm*.
Mare Baulks, 1803. "Mare" is from A.S. *mear*, boundary (Old English *meer*). Vide p. 195.
Margaret's Plot, 1854
(O) Margeholes Wood, 1854.
(O) Marlings, 1854. Probably a *marly* piece of land; cf. saltings, a salt marsh.
(O) Martin's Field, 1803. A Nicholas Martyn, of Bushey, is mentioned in a plea of 1379 (Gesta, iii, 235). A John Martyn was buried at Watford in 1539 (Register).
(O) (Beck) Mason's Wood, 1877.
Mirgins Pightle, 1854. "Mergins; mortar or cement found in old walls; East country" (H.P.).
Money Hill, 1854. A field at Swalecliffe, Oxon, "is called Money Acre from a pot of money found there about 100 years since" (Gough's Camden, 1789, i, 295).
Morgo, 1803. Perhaps A.S. *meare-hoh*, march (boundary) hill; the Icelandic *mörk* is nearer our form than *meare*.
Mournings, 1854.
Munn's Folly, 1803. Isabel M. of Watford married 1593 (H.G., i, 13).
(O) Mutchetts or Mutchins. Eliz. Mutchet, of Abbot's Langley, married 1594 (H.G., i, 13).
(O) Mutton's Wood, 1877.
(O) Myrydenmede, 1357 (Gesta, iii, 90). Cf. Merry Hill, Bushey; perhaps from A.S. *myre*, *mære*, *mara*, Dutch *merrje*, a goblin, English night-*mare*; this class of goblin-names is a large one, e.g., Devil's Dyke, Grim's Ditch, Hobb's Hole, Lubber's Down, etc.
(O) Nanscot Wood, 1877.
Nascot.
New House. The name occurs as far back as 1659 (Cuss., 'Cass. Hund.,' 182).
Newket, 1803. Probably a dialectical variety of *nooket*, a little nook; a *nook* is a quarter yard land (H.P.). The name occurs at King's Langley as "Nucket."
Newlands, 1854. "Land lately broken up and ploughed; Kent" (H.P.).
(O) Nicholas Field, 1854.

(O) Nomansland or Nemansland, 1803. Vide p. 194.
(L) Nut Beam Field, 1854. A.S. *beam*, a tree.
Otterspool, 1780.
Oxhey; occurs in 790 as Oxongehaege, i.e. the hedge or enclosure for oxen.
Packer Field, 1854. Joan, daughter of Nicholas Packer, was baptized at Watford in 1539 (Register).
(O) Palmer's Field, 1354.
Parker's Croft, 1803. Mr. Rogers Parker owned the Munden estate from 1787 to 1828 (Cuss., 'Cashio Hund.,' p. 181).
Parlour Field, 1854.
Payne's Piece, 1854. Mary, daughter of Samuel Blackwell, who married William Payne, Esq., was buried at Watford in 1669.
(L) Pen Long Cutts or Cott. "Pen" means an enclosure, from A.S. *pinan*, to press; for "cutts" vide Cut Croft.
Penman's Pightle, 1877. In 1803, Penmer's; old O.S. Penmore; this change is exactly parallel to that of Rick*mers*worth to Rick*mans*worth.
(O) Pesecroft, 1456 (Reg. Whet., i, 223).
Pest-house Field. The pest-house, which still stands, was an isolated house to which people suffering from infectious disease could be sent in case of need.
Pettifers, 1854.
Phipp's Lane, 1854.
(O) Piper's Field. Vide Blacksmith's Field, and p. 196.
Plat Field, 1803.
Poor Hill, 1803.
Pope's Croft, 1854.
Potter's Field, 1854.
Pow Field, 1854.
Prescot Field, 1803.
Queeches. Drayton, in his 'Polyolbion' (1613), speaks of "Goodwin's queachy sand"; it means shaking, or moving. Cf. *quag*-mire, which belongs to the same root as *quick*.
Range, 1854; Reins, 1803.
(O) Raymonds, 1854.
Reade's Field, 1803.
Reddings Wood, 1854. The name occurs as Readings, Ridings, or Riddings; it means a green ride.
Redheath.
Ricketts Field, 1854.
Roundabout, The, 1854.
Rousebarn. Hen. Rowce, party to a deed concerning a messuage in Watford, 1527 (H G., i, 137).
Row, The, 1854. A provincial word for hedge.
Rull Field, 1803.
Runnington's Field, 1854. The name occurs in Watford towards the end of the seventeenth century.
Russell Farm. Probably named after John Lord Russell, who

was given charge of the St. Alban's Abbey property in Watford after the Dissolution in 1544. Newcome's 'History of St. Albans Abbey,' p. 515.

Saddler's Stile Field, 1854.

(O) St. Clowes or St. Cleeres, 1601 (Cuss., 'Cash. Hund.,' p. 174). In Norden's Map (1673), Sinklees; the name of the house which stood on the site of Oxhey Place.

Salmon's Field, 1854.

Saunder's Field, 1854.

Scotch Ley, 1803. Probably a corruption of *shot* or *scot*.

Shallow Croft, 1803.

Shamble-pond Field, 1803.

Sharats, 1803.

(L) Sheldon Croft, 1854.

Shepherd's Mead, 1854.

(O) Sherwood's Wood.

Shittle Croft, 1803. The Middle English *schyttyl* means the bar of a door; can this name mean the barred or fenced croft?

(O) Shoulder of Mutton Field, 1854.

Shrowdells or Shrodells, 1854. On comparing this name with Shrofdeles and Shrofdole, which occur at Bicester, Oxon, in 1325, it seems that the full form must be Shrove-doles, perhaps a common field or meadow which was *doled* out among the commoners at *Shrove* Tide; the name Shrovedoles also occurs at Winslow, Bucks, in 1361.

(O) Sidelands, 1854. Vide p. 200.

Silver Field, 1854.

(O) Silvester Field, 1854.

(O) Simmon's Mead, 1854.

(O) Sixpenny Hill. There is a Sixpenny Common at Stevenage; we may probably refer the name to the same source as that of Penny Ham at Cote, near Bampton, Oxon, which was put up to auction every year among the commoners, and which sold for a penny in wet seasons ('*Archæologia*,' xxxiii, 269).

Slad Field, 1803. A.S. *slæd*, a narrow valley; "a breadth of greensward in a ploughed field, or in plantations" (H.P.). For the literary use of the word, cf. Drayton's 'Polyolbion' (1613), "satyrs that in slades and gloomy dimbles dwell," vol. ii, p. 690.

Soot House Field, 1854.

Staggs, 1803.

(L) Stanboroughs, The, 1854.

Stanes.

Stanishot, 1803. Probably, like "Stanes," so called from the boundary stones, such as may still be seen on the Common Moor, near Bricket Wood.

Stapel Field, 1803. A.S. *stapel*, a branch or stump.

Starve Acre, 1854. Cf. Hungerlands.

(O) Stocked Field, 1854. To "stock" is to grub up trees by the roots.

Tane's Mead, 1803. Jesse Tain, of Watford, was married at Bushey in 1697 (Register).

(O) Thorpe's Mead, 1854.

Thrale's Field, 1803.

Thrums, 1854. Icelandic *thröme*, edge; Norwegian *trumm*, edge; German *trumm*, stump, end; hence "Thrums" probably means rough, broken ground.

Tithe Acre, 1803.

Tolpits, 1877; Tolput, 1803; Twopits, 1822. The name occurs in 1364 as Tolpade (Cuss., 'Cashio Hund.,' p. 137). Vide p. 201.

Tom's Hill, 1854.

Tooley's Land, 1583.

(O) Turner's Ley, 1854.

Vow Field, 1854.

Ward's Field, 1803.

Ware Field, 1803. This is probably a mere variation in the spelling of "weir."

Watson's Mead, 1803.

(Home) Weathers, 1803.

(O) Welpley's, 1854. Thos. and Anne Whelpley, parties to deed concerning lands at Oxhey, 1521 (H.G., i, 83).

(L) Wheeler's Field, 1854. A John Wheolare, of Watford, is mentioned in a plea of 1384 (Gesta, iii, 239).

Whippendell. The name occurs as Whippeden in 1364 (Gesta, iii, 117); cf. Whipping Spring at Rickmansworth.

White's Close, 1854.

Whiteway Field, 1854.

Whitman's Croft, 1803.

Whitmore Green, 1822.

(O) Wiggenhall. Whithynhalle in 1374; Wygenhale in 1380; Whythgynhall in 1538. Probably, as the River Colne is close by, from A.S. *withig*, *withigan*, the hall of the withy or willow.

Winch Field, 1854. A.S. *wincel*, a corner; cf. *winkle*, the twisted shell. A Gilbert atte Wynche was juror in an inquisition in the adjoining parish of Little Langley in 1329 (Gesta, ii, 273).

Woolmer's Field, 1854.

(First) Worthies, 1803. "Worth; a nook of land, generally lying between two rivers" (H.P.); from A.S. *weorthig*, estate.

XXIX.

REPORT ON THE RAINFALL IN HERTFORDSHIRE IN THE YEAR 1899.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

The number of rainfall returns received for the year 1899 is about the same as that for the previous year and greater than any up to that year. The principal table contains the monthly records for 45 stations, being three less than for 1898 and one more than for 1897. Three stations have been discontinued—London Road, Royston; Nash Mills, Hemel Hempstead; and The Lawns, Southgate. The loss of the Royston station is due to the death of the veteran observer, Mr. Hale Wortham, whose meteorological observations have for many years appeared in the 'Quarterly Returns of the Registrar General'; and that of the Southgate station also to the death of the observer, Mr. George A. Church. The discontinuance of the observations at Nash Mills closes the longest record of rainfall in the county, a complete record for 57 years. The gauge at Apsley Mills is, however, so near to the old Nash Mills gauge that it may be considered to take the place of it. Two other stations are omitted—Bulbourne and Cowroast, Tring. The returns from these stations have, however, been received, but after this table was in type and the Report written, and therefore too late to incorporate in it. Against these losses are two additions—Royston Workhouse, which will take the place of the late Mr. Wortham's station; and Fairhill, Berkhamsted, a former station reinstated.

The number of daily records received is 34, which is two less than the number for 1898 and one less than that for 1897.

Particulars of the 45 rainfall stations, and the monthly and total rainfall and number of days of rain in 1899, are given in Tables I and II, pp. 215–217.

A supplementary table (Table III, p. 218) gives nine other records of the total rainfall in the year. Two are the records of additional gauges at Rothamsted, one is that of an additional gauge at Odsey, two are the returns from Bulbourne and Cowroast received too late for insertion in the principal table, and four are taken from 'British Rainfall, 1899.'

The mean rainfall in the county in the year 1899 was 24·53 inches. This is 2·21 inches below the average for the decade 1880–89, and 1·80 inch below that for the half-century 1840–89. The year was, therefore, one of rather small rainfall, this being due chiefly to the dryness of March and August. The mean number of wet days in the year was 148, being 20 less than the average for the twenty years 1870–89. Twice only during this period has a smaller number been recorded—in 1884 when the number was 141, and in 1887 when it was 146.

Droughts in 1899.—Droughts—"absolute" of more than 14 days' duration, or "partial" of more than 28 days with an average of less than 0·01 inch of rain per diem—occurred in February–March, May-June, and November. The first absolute drought was in February–March, at 24 stations, and lasted for 20 days, Feb. 16 to March 7, at one station; 19 days, Feb. 17 to March 7, at three stations; 18 days, Feb. 18 to March 7, at two; 16 days, Feb. 16 to March 3, at twelve; 16 days, Feb. 20 to March 7, at one station; 15 days, Feb. 17 to March 3, at three stations; and 15 days, Feb. 21 to March 7, at two. The second absolute drought was in May–June, at 34 stations, and lasted for 25 days, May 25 to June 18, at one station; 24 days, May 25 to June 17, at twenty-five stations; 23 days, May 26 to June 17, at two; 22 days, May 27 to June 17, at five; and 19 days, May 30 to June 17, at one station. The third absolute drought was in November, at 23 stations, and lasted for 21 days, Nov. 10 to 30, at two stations; for 20 days, Nov. 11 to 30, at eight stations; for 19 days, Nov. 12 to 30, at eight; for 17 days, Nov. 14 to 30, at two; for 16 days, Nov. 15 to 30, at two; and for 15 days, Nov. 16 to 30, at one station. Notwithstanding this drought, November was the wettest month in the year, the first nine days in the month being excessively wet.

There was one partial drought in February–March at thirty stations for 33 days, Feb. 16 to March 20, with an average of 0·007 inch of rain per diem. At fifteen stations it lasted for 37 days, Feb. 16 to March 24, with an average of 0·008 inch of rain per diem.

Distribution of the Rainfall throughout the Year.—Of the total rainfall of 24·53 inches, 5·31 inches fell during the first quarter of the year, 6·43 inches during the second, 5·00 inches during the third, and 7·79 inches during the fourth. During the winter of 1898–99 (Dec. to Feb.) 7·27 inches fell, during the spring of 1899 (March to May) 5·50 inches, during the summer (June to August) 4·45 inches, and during the autumn (Sept. to Nov.) 8·47 inches. March and August were very dry months; June, July, and December were rather dry; in February, May, and September the rainfall was about the average; January, April, and October were wet; and November was very wet, although scarcely any rain fell after the first nine days, these days having nearly five times their average fall.

The difference in each month from the mean for the half-century was as follows:—Jan., + 0·28 in.; Feb., + 0·31; March, — 0·91; April, + 0·82; May, + 0·07; June, — 0·47; July, — 0·68; August, — 1·38; Sept., — 0·25; Oct., + 0·23; Nov., + 1·02; Dec., — 0·48.

The absolute maximum falls in any one day in each month, and the stations recording them, were—Jan. 15, The Maples, Hitchin, 0·53 in.; Feb. 6, Moor Park, Rickmansworth, 0·60 in.; March 28, Datchworth, 0·37 in.; April 16, Therfield, 0·93 in.; May 12, Welwyn and Datchworth, 0·84 in.; June 30, Rose Cottage, Berkhamsted, 1·28 in.; July 22, Northchurch, 1·69 in.; Aug. 15,

TABLE I.—HERTFORDSHIRE RAINFALL STATIONS, 1899.

District.	Station.	Observer.	Diameter of Gauge.	Height of Gauge above		
				Ground.		Sea-level.
			ins.	ft.	ins.	ft.†
1.	Royston—Melbourne Street	Joseph E. J. Phillips	8	0	11	201
,,	,, Union Workhouse	J. W. Wesson	5	1	0	217
,,	*Odsey	H. George Fordham	5	1	0	256
2.	*Baldock—High Street	F. W. Langston Day	5	1	4	214
3.	Hitchin—The Firs	William Lucas	5	2	1	238
,,	* ,, Bancroft	Francis Ransom	5	0	9	212
,,	,, The Maples	William Hill.....	8	1	1	220
,,	* ,, High Down	Joseph Pollard	5	1	3	422
4.	Tring—Pendley Manor	J. G. Williams.....	5	2	0	500 ?.
6.	Cowroast—Offside Cottage...	Richard Leah	5	1	6	420
,,	*Northchurch—The Limes...	F. L. Sutton.....	5	1	0	400 ?
,,	*Berkhamsted—Fairhill	W. B. Hopkins	5	1	0	547
,,	* ,, Rosebank ...	Edward Mawley	8	1	0	401
,,	* ,, Rose Cottage	W. E. Milner	5	1	0	334
7.	*Great Gaddesden Vicarage...	Rev. W. T. T. Drake	8	1	0	427
,,	*H. Hempstead—Apsley Mills	J. Dickinson & Co. ...	24	0	9	260
,,	Kg.'s Langley—Laurel Bank	Isaac Butler	5	1	0	283
,,	Chipperfield—Little Callipers	Arthur W. Rivington	5	0	7	407
8.	*Kensworth—The Grove	Miss S. Grace Jones	5	1	0	630 B
,,	*Harpenden—Rothamsted ...	Lawes and Gilbert ...	5	0	9	420 T
,,	*St. Albans—Gorhambury ...	W. Newberry	5	1	0	423 T
,,	* ,, The Grange ...	John Hopkinson	5	1	0	380
,,	* ,, Boue Hill	H. J. T. Broadwood	5	1	0	336
9.	* Elstree—Aldenham House	Edwin Beckett	10 sqr.	4	9	305
10.	*Watford—St. Albans Road	H. Ruddle.....	5	1	0	250 ?
,,	* ,, London Orphan Asylum	Dr. O. C. Cockrem	5	1	0	231
,,	* ,, Frogmore	Arthur P. Blathwayt	5	1	0	182
,,	,, Colne Val. Water W'ks.	William Verini.....	5	1	0	220
,,	*Rickmansworth—Moor Park	Lord Ebury	5	2	0	340
12.	*Welwyn—Bridge House ...	B. Wilfred Thomas ...	5	0	6	228 ?
,,	*Datchworth Rectory	Rev. Andrew Amos ...	5	1	0	386 T
,,	Hertford—Marden Hill.....	Richard Hoare	5	1	0	257 T
,,	*Stevenage—Weston Park ...	M. R. Pryor	5	0	8	470 T
13.	*Bennington—Desmond Cottage	Miss M. C. Nihill.....	5	1	0	408
,,	* ,, Bennington House ..	Rev. Dr. Parker	5	1	0	408
14.	*Therfield Rectory	Rev. J. G. Hale	5	4	0	510
,,	*Throcking Rectory...	E. Wallis	5	1	0	484 T
,,	*Buntingford—Hamels Park	T. Woodham Mott ...	5	1	0	400 T
15.	*Much Hadham	William Cowper	5	1	0	222 B
16.	Harlow—Gilston Park	W. Clinton Baker ..	8	0	6	175
17.	*Hertford—Bayfordbury.....	Joseph Francis	8	1	2	250
,,	*Ware—Red House	Miss V. M. Croft.....	5	0	9	112 T
,,	* ,, Fanhams Hall	G. J. Newbery	8	1	0	253 T
18.	*Broxbourne—Stafford House	T. H. Martin	5	1	0	118 T
,,	*New Barnet—Gas Works ...		8	0	9	212

* Daily fall received. † For explanation of these symbols see Vol. VII, p. 53.

TABLE II.—RAINFALL IN HERTFORDSHIRE IN 1899.

River Districts.		Stations.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.	Days.
			in.	in.	in.	ins.	ins.	ins.	in.	in.	in.	ins.	ins.	ins.	ins.	
OUSE	CAM	1. Rhee — Royston—Melbourne Street	2·04	1·29	·85	2·16	1·91	1·33	1·70	1·03	2·25	1·91	3·03	1·54	21·04	137
		1. Rhee — ,, Union Workhouse	2·12	1·29	·86	2·25	1·98	1·41	1·88	·92	2·15	1·95	2·97	1·51	21·29	130
		1. Rhee — Odsey	1·84	1·25	·68	2·73	2·08	1·33	1·30	·72	1·72	1·94	2·77	1·57	19·93	156
	IVEL	2. Upper Ivel — Baldock—High Street	1·96	1·50	·61	2·55	2·06	1·00	2·10	·68	2·33	2·89	2·91	1·50	22·09	137
		3. Hiz — Hitchin—The Firs	2·46	1·53	·68	2·30	1·73	1·31	1·53	1·27	2·09	3·14	3·53	1·59	23·16	154
		3. Hiz — ,, Baucroft	2·39	1·54	·68	2·34	1·78	1·25	1·40	1·30	1·95	3·11	3·28	1·48	22·50	154
		3. Hiz — ,, The Maples	2·45	1·45	·67	2·47	1·75	1·21	1·38	1·21	1·88	3·06	3·25	1·36	22·14	138
		3. Hiz — ,, High Down	2·54	1·63	·69	2·48	1·77	1·21	1·69	·91	2·33	2·94	3·04	1·53	22·76	158
	THAME	4. Up. Thame — Tring—Pendley Manor	3·07	2·73	·63	2·73	2·36	1·67	2·67	1·56	2·58	3·29	3·49	1·67	28·45	154
THAMES	COLNE	6. Bulbourne — Cowroast—Offside Cottage	3·02	2·69	·71	2·76	1·92	1·72	2·59	2·04	2·36	2·98	3·37	1·50	27·66	155
		6. Bulbourne — Northchurch—The Limes	2·61	2·41	·64	2·74	1·91	2·00	2·66	·90	2·22	2·58	3·32	1·30	25·29	134
		6. Bulbourne — Berkhamsted—Fairhill	2·47	2·31	·68	2·57	2·15	1·84	2·04	1·05	2·24	2·86	3·41	1·37	24·99	156
		6. Bulbourne — ,, Rosebank	2·78	2·43	·66	2·69	2·13	1·93	2·27	·87	2·22	3·05	3·41	1·44	25·88	154
		6. Bulbourne — ,, Rose Cottage	2·79	2·40	·70	2·67	2·13	2·06	2·18	·90	2·16	3·21	3·50	1·39	26·09	157
		7. Gade — Great Gaddesden Vicarage	2·94	2·42	·60	2·82	2·21	1·85	2·01	1·49	2·35	3·15	3·28	1·28	26·40	139
		7. Gade — Hemel Hempstead—Apsley Mills	3·04	2·71	·79	2·59	2·42	1·64	1·61	·93	2·41	3·91	3·73	1·46	27·24	146
		7. Gade — King's Langley—Laurel Bank	3·12	2·67	·74	2·37	2·49	1·60	1·56	1·00	2·28	3·79	3·78	1·40	26·80	
		7. Gade — Chipperfield—Little Callipers	2·68	2·45	·60	2·01	2·64	1·15	1·76	·59	1·88	3·59	3·46	1·26	24·07	
		8. Ver — Kensworth—The Grove	3·07	2·28	·60	2·89	2·32	1·35	2·40	1·48	2·80	2·69	3·47	1·56	26·91	143
		8. Ver — Harpenden—Rothamsted	2·79	2·33	·80	2·61	2·64	1·48	1·18	1·01	2·36	3·60	3·68	1·36	25·84	151
		8. Ver — St. Albans—Gorhambury	2·68	2·33	·68	2·40	2·75	1·52	2·40	1·04	2·57	4·09	3·49	1·41	27·36	154
		8. Ver — ,, The Grange	2·86	2·39	·66	2·54	2·63	1·69	2·20	·79	2·51	3·02	3·77	1·50	26·56	165
		8. Ver — ,, Bone Hill	2·78	2·27	·63	2·42	2·74	1·76	2·16	·62	2·36	3·03	3·68	1·42	25·87	162
		9. Up. Colne — Elstree—Aldenham House	2·82	2·24	·78	2·76	1·78	2·12	2·42	·88	2·24	2·78	4·26	1·56	26·64	165
		10. Lo. Colne — Watford—St. Albans Road	3·10	2·68	·57	2·84	1·74	1·26	1·19	·80	1·99	3·37	4·37	1·22	25·13	
		10. Lo. Colne — ,, London Orphan Asylum.	2·92	2·43	·58	2·43	1·66	1·75	1·37	·83	1·90	2·49	3·95	1·56	23·87	145
		10. Lo. Colne — ,, Frogmore	2·49	2·30	·57	2·41	1·60	1·64	1·43	·95	1·86	2·40	3·75	1·39	22·79	147
		10. Lo. Colne — ,, Colne Valley Water Works	2·89	2·43	·67	2·54	1·70	1·82	1·46	·94	1·91	2·60	3·86	1·52	24·34	144
		Rickmansworth—Moor Park	3·37	2·79	·70	2·85	1·93	1·84	1·07	·92	2·07	3·42	4·73	1·64	27·33	155
	LEA	12. Mimram — Welwyn—Bridge House	2·73	1·99	·74	2·86	3·26	1·66	1·31	·77	2·13	2·89	3·66	1·32	25·32	143
		12. Mimram — Datchworth Rectory	2·64	2·08	·85	2·78	3·14	1·77	1·49	1·64	2·03	2·72	3·79	1·49	26·42	132
		12. Mimram — Tewin—Marden Hill	2·45	1·63	·55	2·29	2·70	·86	2·38	·76	2·12	2·25	3·37	1·47	22·83	124
		13. Beane — Stevenage—Weston Park	2·49	1·65	·84	2·57	2·12	1·37	2·14	·92	2·41	2·04	3·53	1·52	23·60	154
		13. Beane — Bennington—Desmond Cottage	2·13	1·59	·75	2·78	3·04	1·27	1·74	1·74	2·13	2·05	3·39	1·46	24·07	153
		13. Beane — ,, Bennington House	2·24	1·77	·66	2·68	2·59	1·61	1·90	1·59	2·28	2·30	3·72	1·45	24·79	170
		14. Rib — Therfield Rectory	2·05	1·45	·67	2·82	1·74	1·44	1·78	·81	1·97	2·26	3·22	1·57	21·78	145
		14. Rib — Throcking Rectory	2·22	1·66	·80	2·68	2·45	1·55	1·42	1·34	2·52	2·16	3·83	1·60	24·23	182
		14. Rib — Buntingford—Hamels Park	2·40	1·60	·90	3·14	2·47	1·83	1·63	1·39	2·09	2·02	3·59	1·61	24·67	132
		15. Ash — Much Hadham	2·35	1·72	·93	3·00	2·47	2·01	1·77	·82	2·05	2·26	3·81	1·69	24·88	145
		16. Stort — Harlow—Gilston Park	2·49	1·68	·69	3·15	2·19	2·20	2·12	·74	2·09	2·06	3·75	1·67	24·83	122
		17. Upper Lea — Hertford—Bayfordbury	2·45	1·89	·71	2·37	2·37	2·11	1·59	·48	1·91	2·06	3·45	1·54	22·93	157
		17. Upper Lea — Ware—Red House	2·21	1·58	·68	2·26	2·29	1·96	2·26	·69	2·16	1·88	3·56	1·33	22·86	137
		17. Upper Lea — ,, Fanhams Hall	2·14	1·72	·80	2·32	2·31	2·05	1·79	·88	1·01	2·08	3·85	2·34	23·29	141
		18. Lower Lea — Broxbourne—Stafford House	2·49	1·74	·65	2·55	1·47	2·20	1·44	·54	2·27	1·97	3·70	1·44	22·46	148
		18. Lower Lea — New Barnet—Gas Works	2·84	2·02	·60	2·79	1·42	1·96	1·58	·37	2·78	2·31	4·14	1·47	24·28	136
Mean for the County			2·59	2·02	·70	2·60	2·20	1·63	1·82	1·00	2·18	2·71	3·58	1·50	24·53	148

Offside Cottage, Cowroast, 1·42 in.; Sept. 29, St. Albans Road, Watford, 1·07 in.; Oct. 1, Gorhambury, St. Albans, 2·00 ins.; Nov. 6, St. Albans Road, Watford, 1·15 in.; Dec. 29, Moor Park, Rickmansworth, 0·36 in.

The day in each month on which a heavy fall of rain was most general over the county was—Jan. 15, Feb. 15, March 8 (and 25), April 9 (and 16), May 14 (and 19), June 30, July 22, August 15, Sept. 29, Oct. 1, Nov. 5, Dec. 28; and in the year, Nov. 5.

The average number of wet days in each month was as follows:—Jan., 20; Feb, 11; March, 9; April, 20; May, 12; June, 6; July, 9; August, 8; Sept., 16; Oct., 11; Nov., 11; Dec., 15.

The deviation from the mean for the 20 years 1870–89 was—Jan., +5; Feb., −3; March, −4; April, +7; May, −1; June, −7; July, −5; August, −5; Sept., +3; Oct., −4; Nov., −5; Dec., −1.

Table III.—Supplementary to Tables I and II.

District.	Station.	Observer.	Gauge.		Rainfall.	Days.
			Diameter.	Height above Sea.		
			ins.	feet.	ins.	
1.	Odsey (2nd gauge)	H. G. Fordham..	5	256 ⩛	19·91	157
3.	Hitchin—Preston	R. de V. Pryor....	8	480 ⩛	23·52	146
4.	Tring—Elm House	E. J. Le Quesne..	5	460	25·77	144
,,	Bulbourne	Gordon Thomas..	5	401 ⊤	25·03	161
6.	Cow Roast	,,	5	394 ⩛	27·72	133
8.	Harpenden—Rothamsted	Sir J. Lawes and	8	420 ⊤	25·06	142
,,	,, ,,	Sir H. Gilbert....	72 × 87	420 ⊤	27·13	161
12.	Welwyn—Danesbury	A. M. Blake.....	5	400	25·35	139
18.	Northaw—Northacre	Rev. F. W. Poland	5		25·22	164

Distribution of Rainfall throughout the Year.—The following table (Table IV, p. 219) gives the mean fall in each month and for the year in each of the five river-districts represented, and in the two main hydrographical divisions of the county, the catchment-basins of the Great Ouse and of the Thames, and also the difference in the year from the mean for the decade 1880–89.

The mean fall in each of the minor river-basins or sub-districts represented was as follows:—(*Cam*) Rhee, 20·75 ins.; (*Ivel*) Upper Ivel, 22·09 ins.; Hiz, 22·64 ins.; (*Thame*) Upper Thame, 28·45 ins.; (*Colne*) Bulbourne, 25·98 ins.; Gade, 26·13 ins.; Ver, 26·51 ins.; Upper Colne, 26·64 ins.; Lower Colne, 24·69 ins.; (*Lea*) Mimram, 24·86 ins.; Beane, 24·15 ins.; Rib, 23·56 ins.; Ash, 24·88 ins.; Stort, 24·83 ins.; Upper Lea, 23·03 ins.; Lower Lea, 23·37 ins.

The total yearly fall ranged from 19·93 inches at Odsey to 28·45 inches at Pendley Manor, Tring; and the total monthly fall from 0·37 inch at New Barnet in August to 4·73 inches at Rickmansworth in November. The greatest fall in any one day was 2·00 inches at Gorhambury, St. Albans, on the 1st of October.

TABLE IV.—RAINFALL IN THE RIVER-DISTRICTS.

MONTHS.	CAM.	IVEL.	THAME.	COLNE.	LEA.	OUSE.	THAMES.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	2·00	2·36	3·07	2·86	2·39	2·22	2·66
Feb.	1·28	1·53	2·73	2·45	1·73	1·44	2·15
March	·80	·67	·63	·67	·74	·71	·70
April	2·38	2·43	2·73	2·60	2·69	2·41	2·64
May	1·99	1·82	2·36	2·17	2·38	1·88	2·27
June	1·36	1·19	1·67	1·70	1·74	1·26	1·72
July	1·62	1·62	2·67	1·90	1·77	1·62	1·86
August	·89	1·07	1·56	1·00	·97	1·00	1·00
Sept.	2·04	2·12	2·58	2·23	2·12	2·09	2·19
October	1·93	3·03	3·29	3·13	2·21	2·62	2·74
Nov.	2·92	3·20	3·49	3·71	3·65	3·10	3·68
Dec.	1·54	1·49	1·67	1·43	1·56	1·51	1·49
Year	20·75	22·53	28·45	25·85	23·95	21·86	25·10
Diff. from 1880–89	—2·75	—2·74		—3·12	—1·60	—2·62	—2·25

Distribution of the Rainfall in each Month.—The nomenclature used in the following account of the chief falls of rain is the same as in my previous reports, falls of at least ½ inch being styled *considerable*, ¾ inch *very considerable*, 1 inch *great*, 1¼ inch *very great*, 1½ inch *heavy*, 1¾ inch *very heavy*, and 2 inches *excessive*. This analysis only applies to the thirty-four stations for which I have returns of the daily rainfall. The wettest days which are given in each month are those at forty-five stations.

JANUARY.—A wet month, almost entirely without snow, with many wet days. During the first twenty-three days there were not more than three without rain at most stations. The only *considerable* fall was on the 15th at four stations. The 13th was the wettest day at one station, the 15th at 33 stations, the 20th at 10, and the 15th and 20th were the wettest at one station.

FEBRUARY.—Also a wet month, but all the rain, except 0·01 or 0·02 in. at a few stations, fell during the first fifteen days. A little snow fell on a few days during the first week. There was a *considerable* fall of rain and snow at one station on the 6th, and of rain at one on the 8th. The 4th was the wettest day at 2 stations, the 6th at 10, the 8th at 9, the 15th at 21, the 8th and 15th were the wettest at one station, and the 6th, 8th, and 15th at two stations.

MARCH.—Very dry, and nearly all the precipitation in the form of snow. For the first seventeen days on only two on the average did any rain or snow fall, a very dry period having thus lasted for more than a month. There was no *considerable* fall of rain. The 8th was the wettest day at 21 stations, the 21st at 3, the 25th at 17, the 28th at one station, and the 8th and 25th were the wettest at 3 stations. On the 21st about four inches of snow fell at Royston in two hours.

April.—A wet month, with a little snow and hail during the first half, and many wet days. There was a *considerable* fall of rain on the 9th, 13th, and 20th at one station in each instance (but not the same one), and on the 16th the rain was *considerable* at 6 stations and *very considerable* at 2, none of these being in the Colne district. The 6th was the wettest day at 2 stations, the 9th at 15, the 13th at 6, the 16th at 14, the 20th at 5, the 24th at one station, the 9th and 13th were the wettest at one, and the 9th and 22nd at one.

May.—Rather wet, with about the average number of wet days, nearly all within the middle fortnight of the month. On the 12th the fall was *considerable* at 2 stations and *very considerable* at 2; on the 19th it was *considerable* at 9 stations and *very considerable* at one station; on the 23rd it was *considerable* at 2 stations, and on the 24th at two. The 12th was the wettest day at 5 stations, the 14th at 13, the 19th at 13, the 21st at one station, the 23rd at 8 stations, and the 24th at 5.

June.—Rather dry, with rain on very few days, all during the second half of the month. On the 28th the fall was *considerable* at 2 stations, and on the 30th it was *considerable* at 10, *very considerable* at 12, *great* at Fanhams Hall, Ware (1·00 in.), Broxbourne (1·00 in.), Aldenham House, Elstree (1·02 in.), Great Gaddesden (1·04 in.), Bayfordbury (1·04 in.), London Orphan Asylum, Watford (1·11 in.), Fairhill, Berkhamsted (1·12 in.), Hamels Park (1·13 in.), Moor Park (1·15 in.), Rosebank, Berkhamsted (1·19 in.), and Northchurch (1·22 in.); and *very great* at Rose Cottage, Berkhamsted (1·28 in.). This was the wettest day at all stations, and the mean fall in the county was 0·88 in.

July.—Also rather dry and with very few wet days. More than half the rain in the month fell on 22nd and 23rd. On the 1st the fall was *considerable* at one station; on the 22nd it was *considerable* at 6 stations, *very considerable* at 6, *great* at Bone Hill, St. Albans (1·16 in.), and The Grange, St. Albans (1·20 in.), *very great* at Gorhambury, St. Albans (1·36 in.), and *heavy* at Aldenham House, Elstree (1·50 in.), Kensworth (1·65 in.), and Northchurch (1·69 in.); and on the 23rd it was *considerable* at 3 stations. The fall on these two days was the result of thunderstorms which were the most severe in the west of the county, especially in and near the valley of the Ver. The 1st was the wettest day at 2 stations, the 22nd at 28, the 23rd at 14, and the 22nd and 23rd were the wettest at one station.

August.—A very dry month, and with very few wet days. Nearly all the rain which fell was due to thunderstorms. On the 15th there was a very severe one in North and Mid Herts. On this day the rainfall was *considerable* at 5 stations and *very considerable* at 4. The 15th was the wettest day at 28 stations, the 29th at 11, the 30th at 2, and the 31st at 4.

September.—Rather dry, but with more than the average number of wet days. There were several thunderstorms near the beginning and end of the month. On the 29th the fall was *considerable* at

2 stations, *very considerable* at 31, and *great* at St. Albans Road, Watford (1·07 in.). This day was the wettest at all stations, and the mean fall in the county was 0·83 in.

October.—Rather wet, but with less than the average number of wet days. On the 1st the fall was *considerable* at 6 stations, *very considerable* at 6, *great* at The Grange, St. Albans (1·05 in.), Fairhill, Berkhamsted (1·08 in.), Bone Hill, St. Albans (1·10 in.), Rosebank, Berkhamsted (1·21 in.), St. Albans Road, Watford (1·21 in.), and Great Gaddesden (1·23 in.), *very great* at Rose Cottage, Berkhamsted (1·33 in.), Moor Park (1·40 in.), High Down, Hitchin (1·44 in.), and Odsey (1·47 in.), *heavy* at Apsley Mills, Hemel Hempstead (1·58 in.), and Bancroft, Hitchin (1·66 in.), *very heavy* at Rothamsted (1·78 in.), and *excessive* at Gorhambury, St. Albans (2·00 ins.). On the 27th the fall was *considerable* at 23 stations, *very considerable* at 10, and *great* at St. Albans Road, Watford (1·19 in.); and on the 29th it was *considerable* at 5 stations. The 1st was the wettest day at 27 stations, and the 27th at 18.

November.—Very wet, the rainfall being about 40 per cent. above the average, but the number of wet days was small, being more than 30 per cent. below the average. Nearly all the rain fell on the first ten or twelve days, and at no station was there any after the 22nd. On the 2nd the fall was *considerable* at 4 stations; on the 3rd it was *very considerable* at 30, and *great* at Aldenham House, Elstree (1·00 in.), Datchworth Rectory (1·00 in.), New Barnet (1·04 in.), and St. Albans Road, Watford (1·14 in.); on the 4th it was *considerable* at 7 stations; on the 5th it was *very considerable* at 23, and *great* at The Grange, St. Albans (1·00 in.), Aldenham House, Elstree (1·00 in.), Fairhill, Berkhamsted (1·01 in.), Rosebank, Berkhamsted (1·02 in.), Moor Park (1·03 in.), Rothamsted (1·07 in.), Much Hadham (1·07 in.), Rose Cottage, Berkhamsted (1·08 in.), New Barnet (1·08 in.), Broxbourne (1·10 in.), and St. Albans Road, Watford (1·15 in.); and it was *considerable* at 2 stations on the 7th, and at one station on the 9th. There was thus at least a *very considerable* fall of rain at all the stations on two days in the month, the 3rd when the mean fall in the county was 0·90 in., and the 5th when it was 0·93 in. The mean for the four days 2nd to 5th was 2·64 inches, which exceeds the average for the whole month for the half-century 1840–89. The 3rd was the wettest day at 9 stations, the 5th at 34, and the 3rd and 5th were the wettest at 2 stations.

December.—A rather dry month, but with about the average number of wet days. There was a little snow on a few days just before the middle of the month, and on two or three days before the end. There was no *considerable* fall of rain. The 1st was the wettest day at 3 stations, the 5th at 10, the 28th at 20, the 29th at 8, the 1st and 29th were the wettest at one station, and the 28th and 29th at 2 stations.

Comparison with the Rainfall of the Adjoining Counties.—It may be of interest to compare the rainfall of Hertfordshire in 1899 with that of the adjoining counties. Such a comparison of the monthly

fall is made in Table V. The stations are—for Cambridgeshire, Ely, Wisbech, March, and Cambridge (Observatory); for Bedfordshire, Bedford (The Grove) and Aspley Guise; for Buckinghamshire, Buckingham, Winslow, and Slough; for Middlesex, Harefield, Harrow, and, in London, Camden Square and Old Street; and for Essex, Halstead, Braintree, Chelmsford, Loughton, and Southend.

TABLE V.—THE RAINFALL OF HERTFORDSHIRE IN 1899 COMPARED WITH THAT OF THE ADJOINING COUNTIES.

MONTHS.	CAMBS. 4 stations.	BEDS. 2 stations.	BUCKS. 3 stations.	MDX. 4 stations.	ESSEX. 5 stations.	MEAN. 18 stations.	HERTS. 45 stations.
	ins.	ins.	ins.	ins.	ins.	ins.	ins.
Jan.	1·95	2·12	2·46	2·47	2·17	2·23	2·59
Feb.	1·00	1·53	1·96	2·03	1·67	1·63	2·02
March	·68	·72	·61	·50	·85	·68	·70
April	1·81	1·88	2·02	2·51	2·32	2·15	2·60
May	1·84	2·22	2·33	1·50	1·66	1·84	2·20
June	1·15	1·03	·98	1·63	1·30	1·26	1·63
July	1·77	1·30	1·01	1·45	2·61	1·75	1·82
August	1·13	·87	·97	·58	·77	·85	1·00
Sept.	3·22	1·78	1·99	2·72	2·39	2·52	2·18
October	2·48	2·76	2·43	2·23	1·99	2·31	2·71
Nov.	2·18	2·11	2·82	4·00	3·57	3·07	3·58
Dec.	1·29	1·05	1·43	1·19	1·45	1·31	1·50
Year.....	20·50	19·37	21·01	22·81	22·75	21·60	24·53

It would appear from this table that our rainfall was greater than the average rainfall of the adjoining counties in every month but September. This exception is due to the large amount which fell in the north of Cambridgeshire (at Wisbech and March) in that month.

As the number of stations is much too small to give a trustworthy average, the mean fall in the year at a larger number of stations (one to every 40 square miles in each county) has been computed, care having been taken to select representative stations as widely distributed as possible. The result is as follows:—Cambridgeshire (21 stations), 20·74 ins.; Bedfordshire (12 stations), 20·69 ins.; Buckinghamshire (18 stations), 22·05 ins.; Middlesex (7 stations), 22·87 ins.; Essex (33 stations), 22·98 ins.; the mean for the whole of the 91 stations being 21·97 inches. This value is very near to that given in Table V, and seems to show that in 1899 Hertfordshire had about $2\frac{1}{3}$ inches more rain than the average fall in the counties by which it is surrounded.

XXX.

METEOROLOGICAL OBSERVATIONS TAKEN IN HERTFORDSHIRE IN THE YEAR 1899.

By John Hopkinson, F.L.S., F.G.S., F.R.Met.Soc., Assoc.Inst.C.E.

With much regret I have to announce that, owing to the death of Mr. Hale Wortham, of Royston, on the 18th of April, 1899, in his 77th year, the longest series of meteorological observations in Hertfordshire (excepting those of rainfall or of temperature only) has come to an end, and the number of stations from which this report is drawn up is reduced from five, for the previous twelve years, to four. This is the only alteration which has taken place in the meteorological stations of Hertfordshire during this period.

The observations at the four remaining stations have been taken as usual. The hour of observation is 9 a.m., and all the records are entered to the same day except those of the maximum temperature and the rainfall, which are entered to the previous day. At Bennington, Berkhamsted, and St. Albans the shade-temperature thermometers are in Stevenson screens, in accordance with the regulations of the Royal Meteorological Society; at New Barnet they are under Glaisher stands.

Table I.—*Results of Climatological Observations taken in Hertfordshire in the Year* 1899.

Stations	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Bennington	49·6	41·7	57·5	15·8	16·6	86·1	81	6·6	24·79	170
Berkhamsted	49·7	41·1	58·4	17·3	15·8	86·9	81	6·5	25·88	154
St. Albans.....	49·8	42·0	57·5	15·5	18·2	85·9	80	6·1	26·56	165
New Barnet	49·2	38·2	60·1	21·9	8·5	90·5	81	5·4	24·28	136
County.....	49·6	40·8	58·4	17·6	8·5	90·5	81	6·2	25·38	156

The year 1899 was warm on the whole, although the spring was rather cold. The rainfall was a little less than the average for the sixty years 1840–99, and the number of rainy days was also rather less than the average. Compared with the average of the twelve years 1887–98, the excess in mean temperature was 1°·3, and the rainfall was about an inch greater although the rainy days were twelve less in number. The mean day temperature was more in excess than the mean night temperature, the mean daily range being nearly two degrees greater than usual. The relative humidity

was 1 per cent. less than the average, but as the temperature was high the amount of moisture in the air was about the same as usual. The sky was rather brighter than usual. The mean temperature was between that of the years 1897 and 1898, and the rainfall was a little more than half an inch greater than in the year 1897, and nearly six inches greater than in the year 1898.

TABLE II.—*Means of Climatological Observations (with Extremes of Temperature) for the Seasons of* 1898–99.

Seasons	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Winter	41·9	35·7	48·1	12·4	11·0	65·5	88	6·6	7·46	61
Spring	45·4	36·0	54·8	18·8	8·5	74·0	80	6·4	5·51	42
Summer	63·0	51·6	74·4	22·8	32·0	90·5	71	4·9	4·70	23
Autumn	50·3	42·2	59·0	16·8	23·5	89·3	83	6·4	8·88	39

The winter of 1898–99 (Dec. to Feb.) was exceedingly mild, the days being 5½ degrees and the nights 4 degrees warmer than usual. The air was rather dry, the sky of average cloudiness, and the rainfall very heavy, being 48 per cent. above the average, and on a much larger number of days than usual.

The spring (March to May) was rather cold, both days and nights being so, and the daily range of temperature being about the same as usual. The air was rather humid, the sky of average cloudiness, and the rainfall about 10 per cent. above the average, and on more than the usual number of days.

The summer (June to August) was very warm, the days being nearly 4½ degrees and the nights more than one degree warmer than usual, the daily range of temperature therefore being great. The air was rather dry, the sky very bright, and the rainfall very small, being 31 per cent. less than the average, and on little more than half the usual number of days.

The autumn (Sept. to Nov.) was rather warm, chiefly owing to the warmth of the days, the daily range of temperature being rather greater than usual. The air was dry for the season, the sky a little brighter than usual, and the rainfall heavy, being 22 per cent. above the average, but on less than the usual number of days.

We thus had a very mild and very wet winter, a rather cold and rather wet spring, a very warm and dry summer, and a rather warm and very wet autumn. March, however, was rather dry. January had the greatest excess of temperature (5°·2 above the average), and August the next (4°·3 above the average). December was much the coldest month, having a temperature 2½ degrees below the average.

The above comparisons are with the average of the twelve years 1887–98, and are subject to a little modification owing to the

absence of the Royston station. The temperature there was, as a rule, nearly a degree higher than at the other stations, and the rainfall was about two inches less.

TABLE III.—*Means of Climatological Observations (with Extremes of Temperature) taken at Bennington, Berkhamsted, St. Albans, and New Barnet, during the Year* 1899.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·3	35·9	46·8	10·9	24·0	56·0	90	6·7	2·68	23
Feb.	40·9	33·2	48·5	15·3	11·0	65·5	88	6·0	2·15	12
March	40·0	29·7	50·3	20·6	8·5	61·8	86	5·3	·65	10
April	46·1	38·2	54·1	15·9	19·5	65·0	79	7·4	2·67	21
May	50·1	40·1	60·0	19·9	22·1	74·0	76	6·6	2·19	11
June	59·6	47·8	71·4	23·6	32·0	85·0	73	5·4	1·80	6
July	64·6	54·0	75·1	21·1	43·2	89·5	69	5·1	1·99	9
August	64·9	53·1	76·8	23·7	38·0	90·5	70	4·2	·91	8
Sept.	57·3	48·2	66·4	18·2	29·0	89·3	73	6·3	2·45	17
Oct.	48·6	38·9	58·4	19·5	25·1	65·5	88	5·3	2·67	12
Nov.	45·9	39·5	52·2	12·7	23·5	62·0	88	7·5	3·76	10
Dec.	35·4	30·4	40·4	10·0	12·5	54·8	89	7·9	1·46	17
Year	49·6	40·8	58·4	17·6	8·5	90·5	81	6·2	25·38	156

In the following notes on the months, a few observations taken at other places than our four meteorological stations are included. The observations referred to Hertford are those of Mr. W. Clinton Baker, taken at Bayfordbury, 250 feet above sea-level.

JANUARY.—Exceedingly mild, of average humidity, with a bright sky, and a heavy rainfall on a large number of days. The mean temperature was more than 5° above the average, but half a degree lower than it was in the previous year. A bright sky with heavy and frequent rain is an unusual conjunction. The excess of temperature was a little more due to the warmth of the days than of the nights. On the evening of the 2nd there was a westerly gale, and at Berkhamsted the mean velocity of the wind for the hour from 8 to 9 p.m. reached 25 miles. The fifteen days 8th to 22nd were very warm, the mean temperature being, at Berkhamsted 45°·3, at St. Albans 45°·4, and at Hertford 45°·8; giving a mean temperature for the three places of 45°·5, which is just above that of the spring of this year at our four stations. Rain fell nearly every day up to the 23rd, and there were slight falls of snow on the 2nd and 23rd. On Thursday, the 12th, there was a south-westerly gale, in some places with heavy rain. Considerable damage was done by the wind, the mean velocity of which, at Berkhamsted, reached 28 miles in the hour from 8 to 9 p.m. At Hitchin there were chimney-pots and tiles blown down

and the roads were flooded; at King's Langley a large barn had its roof lifted off and carried some yards away; about Redbourn many trees were blown down and ricks unthatched; two trees fell across the Hatfield and Dunstable line, nearly causing an accident to a passenger train; two large elm-trees were blown down in Canons Park, Ware; and at Cheshunt a fir-tree fell across the road and damage was done to fences and buildings. There was another gale on Saturday the 21st. Mr. Mawley reports that it was the most windy January at Berkhamsted for five years, and had the greatest amount of sunshine for fourteen years except in 1891.

February.—A somewhat similar month to January, being mild and wet, with a bright sky, and of average humidity. The mean temperature was 2°·7 above the average, the excess being due more to the warmth of the days than of the nights. The weather was cold at the beginning of the month, but the temperature rapidly rose, and by the 10th it was unprecedentedly warm. On the 4th the mean temperature was 28°·6 at Berkhamsted, 29°·7 at St. Albans, and 30°·0 at Hertford; on the 7th, 44° at Berkhamsted, 43° at St. Albans, and 45° at Hertford; and on the 10th, 56°·0 at Berkhamsted, 54°·9 at St. Albans, and 46°·5 at Hertford; giving a mean temperature for these three stations of 29°·4 on the 4th, 44°·0 on the 7th, and 52°·5 on the 10th, a remarkable rise at intervals of only three days. While the temperature on the 4th was 8° below the normal for February, that on the 10th was the average for the middle of May. There were gales on the 11th, 12th, and 13th. That on the 11th blew down an ash-tree at Bishop's Stortford, and that on the 13th blew down a very fine elm-tree near Stanborough Cottage on the Great North Road. It was reported in the 'Hertfordshire Advertiser' that "several people were blown down" in this gale at Bushey. The whole of the rain in the month fell on the first fifteen days, except here and there 0·01 or 0·02 in. Snow fell on the 4th, 5th, and 6th. Mr. Mawley reports that this was the most sunny February for the fourteen years over which his records at Berkhamsted extend.

March.—Rather cold, with a rather humid atmosphere, a bright sky, and a very small rainfall on a small number of days. The coldness of the month was entirely due to the low night temperatures, their mean being lower than in any other month in the year, and the absolute mimimum, at Berkhamsted and St. Albans on the 21st, and at Bennington on the 22nd, also being the lowest in the year. Both the mean daily range and the absolute range were therefore great. This was the driest March, except that of 1893, for many years, and it was unusually sunny. There was one very cold week, 19th to 25th, when the mean temperature at Berkhamsted was 31°, being about 10° below that of the month. Snow fell on most days from the 18th to the 25th; to the depth of four inches in the neighbourhood of Royston on the 21st, but the ground was scarcely covered about Berkhamsted and St. Albans. On this day the exposed thermometer at Berkhamsted registered 10°, or 22° of frost.

TABLE IV. — *Climatological Observations taken at* BENNINGTON HOUSE, BENNINGTON. *Latitude:* 51° 53′ 45″ N. *Longitude:* 0° 5′ 20″ W. *Altitude:* 407 *feet. Observer:* REV. J. D. PARKER, LL.D., F.R.Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·0	35·6	46·4	10·8	27·7	54·5	91	6·9	2·24	23
Feb.	41·3	34·8	47·8	13·0	20·3	62·7	89	6·5	1·77	14
March	40·5	31·7	49·4	17·7	19·6	61·8	84	6·1	·66	10
April	46·2	39·2	53·2	14·0	30·3	62·1	80	8·0	2·68	20
May	49·7	41·2	58·2	17·0	31·8	70·5	75	7·7	2·59	13
June	59·5	48·9	70·1	21·2	39·2	82·5	71	5·9	1·61	9
July	64·3	54·4	74·2	19·8	47·3	83·6	67	5·5	1·90	10
August	64·7	54·2	75·2	21·0	44·6	86·1	68	4·3	1·59	9
Sept.	57·1	48·9	65·3	16·4	32·9	84·7	73	6·6	2·28	17
Oct.	49·1	40·2	58·0	17·8	33·2	63·4	86	5·9	2·30	16
Nov.	46·0	40·4	51·6	11·2	28·8	60·8	89	8·2	3·72	11
Dec.	35·5	30·8	40·2	9·4	16·4	53·7	91	8·3	1·45	18
Year	49·6	41·7	57·5	15·8	16·4	86·1	80	6·7	24·79	170

TABLE V.— *Other Meteorological Observations taken at Bennington by the Rev. Dr. Parker.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	29·864	39·6	38·5	40·6	41·9	7	16	87	8·3	8
Feb.	·944	39·7	38·3	40·4	41·4	7	12	130	9·8	4
March	30·117	39·1	37·2	40·1	41·0	6	10	186	10·3	1
April	29·856	46·1	43·4	46·5	46·3	1	13	130	12·6	3
May	30·053	50·6	46·9	51·4	51·0	4	15	213	15·5	1
June	·096	60·4	55·3	61·1	60·1	7	9	263	15·5	1
July	·099	65·4	59·3	65·1	64·3	6	9	274	14·8	1
August	·125	65·6	59·6	66·1	63·2	12	4	279	14·1	0
Sept.	29·889	56·4	52·0	59·0	57·6	5	10	184	12·7	0
Oct.	30·104	48·5	46·6	49·9	51·5	11	8	154	9·8	3
Nov.	·217	45·4	44·0	46·9	48·2	2	16	55	7·8	11
Dec.	29·944	34·9	34·0	39·6	41·4	4	22	46	6·3	16
Year	30·026	49·3	46·3	50·6	51·1	72	144	2001	15·5	49

April.—A month of average temperature and humidity, but very cloudy and wet, the rain being frequent as well as heavy. The nights were a degree and a half warmer than usual and the days just as much cooler; the daily range of temperature was therefore small. On the 8th, 9th, and 11th there were slight falls of snow. The temperature was very variable.

May.—A rather cold and wet month, with about an average amount of humidity and cloud. Both day and night temperatures were equally (or nearly so) below the average. There was a thunderstorm with heavy rain on the 12th. At Berkhamsted, Mr. Mawley reports, during a very heavy shower which occurred early in the morning of the 20th, rain was falling for ten minutes at the mean rate of an inch an hour. No rain fell at our four stations during the last week in the month, except 0·01 in. at Bennington on the 26th, this being the commencement of an absolute drought which lasted until the 18th of June.

June.—Of average temperature, with a rather dry atmosphere, a very bright sky, and an average rainfall on a very small number of days. No rain fell until the 18th, there having been at nearly all stations in the county an absolute drought since the 24th of May, or for 25 days, an unusually long period for an entire absence of rain. The days were rather warmer and the nights rather colder than usual. The three days 4th to 6th were very warm, having a mean temperature about 6° or 7° above the average for the month. At Berkhamsted it was 65°·1, and at St. Albans 66°·5. The maximum temperature on the 5th and 6th was nearly the same; at Berkhamsted and Bennington the 5th was the hottest day, at St. Albans the 6th, and that day was so at most meteorological stations throughout England. The maximum temperature exceeded 80° on each of these three days. On the night of 14th-15th the exposed (grass-minimum) thermometer at Berkhamsted registered 2° of frost, which is an unusually low reading, Mr. Mawley remarks, for the middle of June. The weather again became very warm towards the end of the month, and the 26th was an unusually hot day, the previous night also being very warm. The mean temperature of this day was 70° at Berkhamsted, 67°·7 at St. Albans, and 69°·5 at Hertford. There was a thunderstorm on the 28th, reported from Odsey, Hitchin, Kensworth, and Broxbourne, and again on the 30th, general over the county, when the rainfall at Bennington was 0·84 in., at Berkhamsted 1·19 in., at St. Albans 0·71 in., and at New Barnet 0·87 in.

July.—Very warm, with a very dry atmosphere, a very bright sky, and less than the average rainfall on a small number of days. The mean temperature was 3°·6 above the average, and both days and nights were warm. The 11th was a very warm day, the mean temperature at Berkhamsted being 70°·5, at St. Albans 69°·9, and at Hertford 71°. The four days 18th to 21st were very warm, the mean temperature at Berkhamsted being 69°·3, at St. Albans 70° 2, and at Hertford 70°·6. There were thunderstorms on the 21st, 22nd, and 23rd. On the 22nd, the rainfall at Bennington

TABLE VI. — *Climatological Observations taken at* ROSEBANK, BERKHAMSTED. *Latitude :* 51° 45′ 40″ N. *Longitude :* 0° 33′ 30″ W. *Altitude :* 400 *feet. Observer :* EDWARD MAWLEY, Sec. R. Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·5	36·0	46·9	10·9	26·8	54·2	91	7·3	2·78	23
Feb.	41·3	34·0	48·7	14·7	19·2	63·0	91	6·8	2·43	10
March	40·9	31·2	50·6	19·4	17·5	61·2	86	5·5	·66	10
April	46·5	39·3	53·7	14·4	29·2	65·0	79	7·3	2·69	21
May	50·3	41·1	59·5	18·4	31·4	70·3	73	6·8	2·13	11
June	59·6	47·9	71·2	23·3	35·9	83·1	68	5·5	1·93	6
July	64·4	53·9	75·0	21·1	45·9	85·3	69	5·5	2·27	10
August	65·1	53·0	77·1	24·1	43·5	86·9	71	4·7	·87	7
Sept.	57·3	48·0	66·6	18·6	29·2	86·1	75	6·6	2·22	19
Oct.	48·8	38·8	58·9	20·1	30·1	65·2	90	6·0	3·05	10
Nov.	46·0	39·5	52·4	12·9	28·0	60·3	89	8·0	3·41	9
Dec.	35·3	30·3	40·4	10·1	15·8	54·4	92	7·9	1·44	18
Year	49·8	41·1	58·4	17·3	15·8	86·9	81	6·5	25·88	154

TABLE VII. — *Other Meteorological Observations taken at Berkhamsted by Mr. Mawley.*

Months	Pressure of the atmosphere	Temperature at 9 a.m.				Days of		Bright Sunshine		
		of the air	of evaporation	of the soil		clear sky	overcast	Total hours	Max. in one day	Sunless days
				at 1 ft.	at 2 ft.					
	ins.	°	°	°	°					
Jan.	29·841	39·6	38·5	39·6	41·8	5	17	69	7·4	10
Feb.	·920	38·4	37·3	39·4	41·2	6	8	93	8·7	5
March	30·104	38·4	36·7	39·9	41·7	7	3	154	9·7	1
April	29·836	46·1	43·2	47·4	47·4	1	18	113	11·5	4
May	30·037	51·1	47·0	53·4	53·2	6	11	192	14·0	2
June	·085	61·0	55·4	62·7	61·4	7	7	230	14·1	2
July	·093	65·1	59·3	66·2	65·2	2	10	249	13·5	2
August	·116	65·3	59·9	68·4	68·3	8	3	247	12·5	0
Sept.	29·875	56·3	52·2	59·5	62·2	6	6	164	10·6	1
Oct.	30·092	47·2	45·9	49·3	52·1	8	9	129	8·6	4
Nov.	·199	45·0	43·6	46·0	48·6	1	13	46	7·1	12
Dec.	29·917	34·8	34·0	37·7	41·0	4	20	34	5·3	17
Year	30·010	49·0	46·1	50·8	52·0	61	115	1720	14·1	60

was 0·50 in., at Berkhamsted 0·92 in., at St. Albans 1·20 in., and at New Barnet 0·70 in.

August.—Very warm, with a very dry atmosphere, an exceedingly bright sky, and a very small rainfall on half the average number of days. The mean temperature was 4°·3 above the average, the excess much more due to the warmth of the days than that of the nights, the mean daily range being great. It was by far the warmest and brightest month in the year, and there was more sunshine registered at Berkhamsted than in any previous August. There were two very warm periods of five days each with maxima exceeding 80° for several days in succession at Berkhamsted and almost as continuously at St. Albans. The first period was from the 1st to the 5th, when the mean temperature at Berkhamsted was 67°·5, at St. Albans 68°·0, and at Hertford 67°·3; the second was the 23rd to the 27th, when it was 68°·4 at Berkhamsted, 68°·8 at St. Albans, and 69° at Hertford. The 15th also was a very warm day. The highest temperature in the year was on the 25th, to which date the maxima in all the tables pertain. There was a severe thunderstorm on the 15th, when some damage was done both by the lightning and the wind, a stack being set on fire and a horse killed near Royston, trees struck near Luton and Redbourn, and a tree blown across the Hatfield and Dunstable line near Luton Hoo. During the storm 0·76 in. of rain fell at Datchworth in 20 minutes and 0·80 in. at Knebworth in 19 minutes. At Berkhamsted rain fell for three minutes at the rate of two inches per hour.

September.—Of average temperature, with a very dry atmosphere, a little less cloud than usual, and a little more than the average rainfall on about one-third more than the average number of days. The relative humidity was 9 per cent. below the average. The first week was very warm, and the 5th was a particularly warm day. The maximum temperature given in the tables refers at all stations to this day, and is about 12° higher than the average of the maxima on the 4th and 6th, and 15° higher than on any other day in the month but the 3rd, 4th, and 8th. There were slight thunderstorms on several days during the first week, and on the 6th there was a very severe one in East Herts. At Stanstead Abbotts a large elm-tree was struck, just after 1 p.m., the bark being split down the trunk, and a man sheltering under it was killed. This is one of many similar instances giving a warning, so often unheeded, of the danger of taking shelter under a tree in a thunderstorm. There was also a thunderstorm on the 29th, when there was much the heaviest fall of rain in the month, the fall at Bennington being 0·77 in., at Berkhamsted 0·89 in., at St. Albans 0·90 in., and at New Barnet 0·97 in.

October.—Of average temperature and humidity, with a very bright sky, and rather less than the average rainfall on fewer days than usual. The days were warmer and the nights colder than usual. There was a thunderstorm on Sunday afternoon the 1st, most severe in the north of the county. At Hitchin the lightning

TABLE VIII. — *Climatological Observations taken at* THE GRANGE, ST. ALBANS. *Latitude:* 51° 45′ 9″. *Longitude:* 0° 20′ 7″ W. *Altitude:* 380 *feet. Observer:* JOHN HOPKINSON, F.R.Met. Soc.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·4	35·9	46·8	10·9	27·8	54·2	90	6·4	2·86	25
Feb.	41·3	34·3	48·3	14·0	20·9	62·7	87	6·0	2·39	12
March	40·5	31·3	49·6	18·3	18·2	60·5	85	5·1	·66	10
April	46·4	39·7	53·1	13·4	30·9	62·9	78	7·1	2·54	21
May	50·5	41·8	59·2	17·4	33·0	69·5	77	6·6	2·63	12
June	59·9	49·7	70·2	20·5	39·2	82·0	71	5·7	1·69	6
July	64·2	55·1	73·3	18·2	48·0	84·9	68	5·2	2·20	10
August	65·0	54·6	75·4	20·8	46·9	85·9	70	4·0	·79	9
Sept.	57·5	49·6	65·3	15·7	30·9	84·1	71	6·5	2·51	19
Oct.	48·9	40·5	57·4	16·9	31·2	64·9	88	5·3	3·02	13
Nov.	45·9	40·2	51·6	11·4	29·2	58·8	89	7·2	3·77	10
Dec.	35·5	31·1	40·0	8·9	19·2	52·4	88	7·9	1·50	18
Year	49·8	42·0	57·5	15·5	18·2	85·9	80	6·1	26·56	165

TABLE IX. — *Climatological Observations taken at the* GAS WORKS, NEW BARNET. *Latitude:* 51° 39′ 5″ N. *Longitude:* 0° 10′ 15″ W. *Altitude:* 212 *feet. Observer:* T. H. MARTIN, Assoc. M. Inst. C.E.

Months	Temperature of the Air						Humidity	Cloud, 0–10	Rain	
	Means				Extremes				Amount	Days
	Mean	Min.	Max.	Range	Min.	Max.				
	°	°	°	°	°	°	%		ins.	
Jan.	41·5	35·9	47·0	11·1	24·0	56·0	87	6·3	2·84	20
Feb.	39·6	29·8	49·4	19·6	11·0	65·5	87	4·8	2·02	11
March	38·1	24·6	51·6	27·0	8·5	61·8	88	4·5	·60	9
April	45·5	34·6	56·5	21·9	19·5	64·8	80	7·4	2·79	21
May	49·7	36·3	63·0	26·7	22·1	74·0	80	5·5	1·42	9
June	59·3	44·5	74·1	29·6	32·0	85·0	72	4·6	1·96	5
July	65·3	52·6	78·0	25·4	43·2	89·5	70	4·1	1·58	7
August	65·0	50·5	79·4	28·9	38·0	90·5	70	3·8	·37	6
Sept.	57·1	46·1	68·2	22·1	29·0	89·3	74	5·6	2·78	15
Oct.	47·7	36·0	59·4	23·4	25·1	65·5	87	3·9	2·31	7
Nov.	45·7	38·0	53·4	15·4	23·5	62·0	86	6·8	4·14	11
Dec.	35·6	29·4	40·9	11·5	12·5	54·8	88	7·3	1·47	15
Year	49·2	38·2	60·1	21·9	8·5	90·5	81	5·4	24·28	136

was very vivid for over an hour, and the thunder almost continuous. Rain fell in torrents, and all the low-lying parts of the town became flooded, the streets being covered with water from one side to the other, and looking like rivers. Large hailstones fell just before the storm ceased. The fall of rain on this day was 0·64 in. at Bennington, 1·21 in. at Berkhamsted, 1·05 in. at St. Albans, and 0·35 in. at New Barnet. The heaviest fall in the county was 2 inches, at Gorhambury, St. Albans. At Berkhamsted, between 3 and 4 p.m., rain fell for three minutes at the rate of two inches per hour.

November.—A rather warm and very wet month, with an atmosphere of less than the average humidity and an average amount of cloud. Although the rainfall was 50 per cent. above the average, the number of rainy days was only two-thirds the average, no rain having fallen after the 12th, and in some places after the 10th, except 0·01 or 0·02 in. here and there, this period being the second absolute drought in the year. The excessively wet period of 2nd to 5th has been discussed in the previous report (on the rainfall), but it may be well to give here the fall at our four meteorological stations. This was, at Bennington, 2nd 0·59, 3rd 0·93, 4th 0·39, 5th 0·94 in., 2nd–5th 2·85 ins.; at Berkhamsted, 2nd 0·14, 3rd 0·87, 4th 0·45, 5th 1·02 in., 2nd–5th 2·48 ins.; at St. Albans, 2nd 0·40, 3rd 0·83, 4th 0·51, 5th 1·00 in., 2nd–5th 2·74 ins.; at New Barnet, 2nd 0·48, 3rd 1·05, 4th 0·55, 5th 1·08 in., 2nd–5th 3·16 ins.; giving a mean fall for the four days of 2·81 inches, equal to about 300 tons of water per acre. There was very little sunshine this month, chiefly owing to fog.

December.—Rather cold, of about average humidity, cloudy, and with a rather small rainfall, but on more than the usual number of days. After a week of unseasonably mild weather, there was a sudden fall in temperature, a cold period commencing on the 8th and lasting until the 24th, when the temperature was considerably above the normal, and the last week in the month, although not so warm as the first, was almost as much warmer for the time of the year as that was. Snow fell on the 10th, 11th, 12th, 15th, 22nd, and 27th, but only slightly except on the 12th, when it covered the ground to the depth of about an inch and a half. There was a very small amount of sunshine, owing in some measure to the prevalence of fog, as in November. Under the heading "Signs of a Hard Winter," the 'Hertfordshire Mercury' on the 23rd of September drew attention to the early appearance of the starling in large numbers, stating that this "is said to be a clear indication of the early approach of a severe winter." October was a little warmer than usual, November was considerably warmer, it was not until the 8th of December that cold weather set in, and the winter was of about average temperature.

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ERRATA.

Page lii, line 9, *delete* (genuinely old).
,, 23, ,, 21 from bottom, *for* 98 *read* 89.
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1891 Barclay, Robert P., *High Leigh, Hoddesdon.*
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1876 *Croft, Richard Benyon, R.N., *Fanhams Hall, Ware.*

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1900 Elliman, G. G., 67, *The Broadway, Chesham.*

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1898 Faulkner, Mrs., *The Gables, St. Peter's Park, St. Albans.*

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1879 Gilbert, Sir Joseph Henry, Ph.D., LL.D., D.Sc., F.R.S., F.L.S., F.C.S., F.R. Met. Soc., *Harpenden.*

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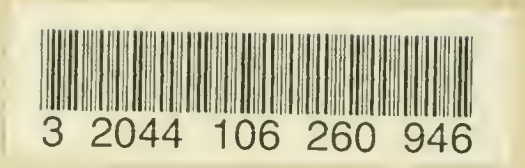
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